Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIV. NEW YORK, SATURDAY, NOVEMBER 26, 1904. No. 22.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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ELECTRICAL WORLD AND ENGINEER.

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United States, Canada or Mexico	Per year, $3.00
Foreign Countries, within the Postal Union	6.00
Great Britain and Ireland	25 shillings
Germany	25 marks
France	31 francs
Single copies	.10

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Entered as second-class mail matter at the New York Post Office.

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REDUCTION OF INSURANCE ON CENTRAL STATIONS.

A point brought out prominently at one of the State electric light conventions the past fall was that many electric light companies are paying unnecessarily high rates for the insurance of their stations against fire, simply because of ignorance of the technical points in construction which would secure lower rates. It was brought out that considerable reductions in insurance rates are made possible by very small and inexpensive changes. The various State underwriter's associations keep for general distribution to those wanting them, copies of the specifications to which buildings must conform to secure the minimum rates, and statements of the amount of premium to be added for the variations from such construction. Many central station men are doubtless not aware of the saving they could easily make in insurance by a little study of these conditions. As a matter of most ordinary business prevision every central station manager should inform himself as to whether his present buildings or a proposed building conform to the minimum rate.

THE SMALL ELECTRIC LIGHT CUSTOMER.

The general public, and we fear many electric light companies also, have not outgrown the old idea that electric light is a rich man's illumination only. There was a time when this was undoubtedly true, but conditions have so changed in the past fifteen years of the electric lighting industry that it is far from true at present. The two principal changes in electric lighting industry which have made possible great reduction in the cost of electric light to small consumers are, first, the perfection of incandescent lamps of less than 16 cp, and, second, the gradual reduction in the cost of current by means of various discount systems. With 16-cp lamps as the smallest unit of light, and with high rates, the cost of electric light was prohibitive in smaller homes, and it is not strange that kerosene and gas have continued the most popular in such places. Both gas and kerosene at usual prices undoubtedly give more total light at a given cost than do incandescent lamps, except where rates are exceedingly low, but that tells only half the story and is misleading, as it is the useful rather than the total light that counts. We have in mind one home where the cost of kerosene to supply lamps was actually greater per month than the cost of electric lights after they were introduced. In this case there were a number of rooms in the house which were used intermittently during the evening, and in order to avoid the great inconvenience of lighting kerosene lamps at different intervals, it was the custom to keep a lamp lighted in each room that was to be used. With electric lights only those actually in use were kept burning, because a light could be had so easily in any room whenever it was wanted. Gas occupies an intermediate position between kerosene and electricity as regards convenience. It can be turned down under conditions where kerosene would be allowed to burn full strength. It is possible, however, to so direct the rays of electric lights by means of reflectors and by proper placing of the lights with reference to the work, as to admit of the use of electric lamps of lower candle-power than would be possible with gas, and in this way where economy is a great object, as it is in the poor man's home, the electric light can be made practically as cheap as gas or kerosene.

We recently talked with the superintendent of a central station company in a manufacturing town of moderate size, who is making very successful efforts to increase the number of workingmen's homes connected to the central station service. He argues that

these small customers are more desirable from the lighting company's standpoint than are the large residences, for a number of reasons. The smaller houses are not so widely scattered as large residences. The regular demand and the maximum demand are not so widely different in the case of a number of small residences as in the case of one large residence, and the income of a given number of lamps connected will be larger in the case of the smaller residences than in the mansions. To be sure, there is more clerical labor required to keep a large number of small meter accounts than the account of one large residence, but this is partially offset by the fact that these small accounts usually give little trouble, and there is less unreasonable kicking from the small customers than from the owner of the large residence who has a very small bill and a very large maximum demand at times. The superintendent we refer to has adopted the plan of paying a small commission to building contractors for securing the wiring of the workingmen's cottages they are erecting. In this way very few workingmen's homes are built in that rapidly growing manufacturing city that are not wired for electric lights. By making it an object for each building contractor to push the introduction of electric light in this way, the company is saved the expense of watching the business and of having solicitors call on every real estate owner who may be building in the town. Building contractors being comparatively few in number and directly in touch with the owners of the buildings they are erecting, they are in position to do easily what it would cost the company considerable to do through special solicitors.

There is probably no more promising field for increase of business in towns where other classes of load have been thoroughly worked up than this field of the lighting of small residences. In order that this class of electric lighting may not suffer on account of its expense to the consumer, it would be well for some one connected with the central station company to make it a business to see that these small consumers are equipped to use electric light economically and to the best advantage. One of the principal points to be looked out for along this line is the use of low candle-power lamps whenever such lamps will give sufficient light for the purpose, the avoidance of waste by turning off lights when not required, and the use of efficient reflectors and globes which will deliver the light at points where it is needed.

A BRITISH REVIEW OF ELECTRIC TRACTION.

One of the valuable papers presented at the recent Congress was a discussion by Mr. Philip Dawson of the adoption of electric traction on British railroads. Mr. Dawson is an engineer well known to the art of electric traction and exceptionally familiar with American practice, which gives his conclusions unusual interest. He points out the exceptionally favorable conditions which exist in England with respect to density of traffic, which is the real determining factor in economy. Given a traffic dense enough and the distribution of power from a central generating station confers a great advantage in cost, while the requirements of such traffic absolutely demand for good service a power of prompt acceleration that is entirely beyond the power of steam locomotives to provide. American interurban lines grow and prosper on traffic far less than would normally fall to the lot of almost any British railway line attempting a change of motive power, so that it would not be in the least surprising if the practical adoption of electricity on railroads of importance proceeded more rapidly across the water than here. Certainly, the average British line has greater possibilities of such sort than the average American line. The only adverse factor which may be considered as affecting British lines is the comparative lack of fierce competition from tramways doing suburban business. As Mr. Dawson very justly remarks, an electrified suburban railway has a very material advantage over a tramway in point of speed. But with the transportation facilities in their present state there is evidently great room for improvement, since as a matter of statistics the journeys per capita in Greater London are less than half those recorded for Greater New York.

As to methods, Mr. Dawson holds strong views which in view of American practice make most interesting reading. For a system of electrical traction suited to heavy suburban and interurban traffic, the conditions to be fulfilled are enumerated by Mr. Dawson substantially as follows: Few and simple sub-stations; simplest possible arrangement of working conductors quite clear of the track; large capacity of working conductor between feeding points; adaptability to both main line and suburban work, and flexibility as regards working voltage to take care of terminal conditions; complete flexibility with respect to speed; simple and safe controlling apparatus; high power factor and capability of high acceleration; perhaps return of current to the line and certainly power of reversal for retardation. This is a very formidable list of requirements. Practically it must be taken as implying a single-phase distribution system with high tension on the working conductors. This is certainly much to be desired, as we have many times pointed out, but we are hardly as sanguine as is Mr. Dawson that it is already in existence. For success it is very necessary not to fall below our present capabilities of efficiency and accelerating power in the motors, and it yet remains to be seen whether a pure single-phase motor of high torque and efficiency and first-class general properties has been produced. At present the case looks more hopeful than it ever has before, but we can hardly accept the series alternating traction motor as a finality yet. It is by no means so simple to change over from alternating current to direct-current operation as Mr. Dawson seems to think, and by the time one has installed the proper controlling apparatus and made provision for taking high-voltage current from the working conductors the equipment has become rather heavy, expensive and complicated, and by no means as simple to operate as Mr. Dawson would wish.

The transformation of alternating to direct current on the train is far from being impracticable on working on a large scale in the class of operations under consideration, and it is an alternative that should be seriously investigated before rejection. Mr. Dawson is outspoken in his condemnation of the third rail supply for surface lines and at the present time we are inclined to think he has a good many sympathizers. When one has arranged a third rail to meet the conditions of high voltage and safety at termini, it has become an overhead conductor. And for collecting current from such a conductor Mr. Dawson strongly recommends the sliding trolley now generally used abroad. This is a radical departure from standard American practice, but we find that a good many engineers who have considered the problem of collecting large amounts of energy have come to a similar conclusion. This, however, is a small matter considering the other magnitudes of the problem. We are a long ways yet from a general method in heavy electric traction, however skillfully special problems may have been solved. Even the experience to be gained in the great work initiated on the New York Central is in meeting special requirements rather than in the larger task of fitting the general suburban road for electric traction. Mr. Dawson takes evidently a more hopeful view of trunk line service than is usual among American engineers, but that is a natural result of the much shorter distances and far denser traffic to be found on English lines. The cheering certainty about the electrification of railways is the increase of traffic which experience has shown to follow a change of motive power. The pure economics of motive

power are of small consequence as compared with the gain in receipts, both gross and net. Doubling the earnings means larger profits per mile of line almost in proportion to the increase, and this goes far to justify the necessarily large cost of so sweeping a change. The work of electrifying railways is certain to go steadily on, and Mr. Dawson's data should encourage our English friends to push ahead.

The New York Central Equipment.

The practical operation of high-speed electric service on the New York Central suburban and terminal lines will be watched with the greatest interest, not only for its bearing on the larger railway work, but by reason of the very striking innovations in the design of the locomotives. Their motor equipment certainly involves more of radical innovation than anything we have seen in electric traction for a decade, and has been already productive of perfervid debate in engineering circles. It must be recognized at the start that the conditions to be fulfilled by these machines are very unusual, and that their field of operations gives far more liberty in design than would be permissible if one were attacking the general problem of heavy railway work. The fundamental requirements were large power and provision for very high acceleration if necessary, together with high normal speed. The situation of the track to be used is, on the whole, very favorable, no very long distances being undertaken, and structurally the roadbed is not only one of the best in the world, but lies largely in tunnels and on viaducts, where a third-rail system is easily installed and maintained, and where the climate at its worst does not have to be encountered. In fact, the operating company can with honor and dignity confine its electric operations to a territory in which no adverse conditions are likely to become prominent. Hence the electrical designer was favored with a larger liberty in some important particulars than generally falls to his lot. The normal speed requirements, for example, allowed the use of bipolar motors without gearing, while still using drivers of practicable size. The same consideration enabled direct driving to be undertaken without the use of enormously heavy armatures, while the possibility of using bipolar motors permitted the remarkable field construction that is so prominent a characteristic of the new locomotives. As our readers probably know, these machines have the armatures carried rigidly on the axles, while the bipolar fields are integral with the truck frame, the poles being so shaped that the armature runs centrally under normal conditions, but can ride up and down between them freely or can be dropped clear out of them for inspection and repairs. In other words, the armature is on the axle and the magnets are on the truck, and supported by it.

The axles are thus relieved of the direct weight of the fields and have as rigid load merely the armatures. This direct carrying of the armatures has been criticised severely as likely to cause undue wear and tear on the track, and as themselves being in considerable danger from the incessant jarring. As regards the first count in this indictment, we fail to see why the rotating armature is as severe a load as the equal or greater dead weight on the axles of a powerful steam locomotive. The shock due to the reciprocating parts of the latter is a serious feature of track wear from which the electric locomotive is entirely free. As to the second count, the innocence of the accused is not quite to clear. The jarring may be sufficient to cause trouble with the windings, but more particularly with the commutators. The fine solid track and roadbed, so favorable in averting wear, lets the commutators get the full benefit of all the jarring that exists. What will happen must be determined by the event, and a prophecy of trouble or immunity from trouble would be largely guesswork, but there is certainly a serious mechanical problem in building a commutator to stand that sort of treatment. As regards the field structure, it is highly original and so far as magnetic efficiency goes appears to be satisfactory. Theoretically it is subject to all sorts of leakage, but the effect of this on the total efficiency of the motor is trivial, and unless it happens to be so unfortunately distributed as to cause sparking, no harm is done. In this case, as often, it appears to do no mischief of such sort and the shape of the pole pieces, while very much out of the usual, does not seem to be such as to cause the sharp variations in flux density that are a common basis of sparking. So long at least as the armatures are nearly central in the fields, the motors seem to be very free from trouble at the commutator. While in this normal condition the idiosyncrasies of design are merely such as may slightly lower the net efficiency of the motor as a whole. This, however, has proved to be amply high up to 93 per cent. in fact, so that the end justifies the means. The only thing to be feared is trouble from the eccentric position of the armatures when the truck rocks and sways in running. The effect of such eccentricity has presumably already been determined in the shop. It certainly might be serious both in causing sparking and irregular torque, with all which that implies. The excellence of the track to be used is here a very favorable condition.

One of the interesting features of the discussion is the train of reasons adduced for choosing a direct-current instead of an alternating-current equipment for this important work. They are, we think, soundly based on the premises, but they throw a curious side light on the general situation as regards alternating motors for electric traction. At the time the decision was made the general state of the art with respect to commutating alternating-current motors was certainly such as would have made a conservative engineer hesitate to tie himself to them for a work of the first order of importance. But how is it at present? In the first place, it is confidently stated that not only would it have been necessary to gear an alternating motor, but that motor would itself have been of several per cent. lower efficiency. If such is the comparison between a large alternating motor and a direct-current motor of a design which does not favor high efficiency, how would the case stand between an alternating street car motor and a standard direct-current motor, in which the design is more favorable to electrical efficiency? Again, it is quite correctly stated that if alternating motors had been used, the weight of the equipment would have been increased by the necessarily greater weight of a motor which delivers a pulsating torque. Is this difficulty any less serious in cars individually equipped with motors than in a locomotive drawing a whole train with four large motors? It is also admitted that the cost of the locomotive equipment would have been considerably raised by using alternating motors. How about the increased cost when one uses a dozen motors instead of four to secure the same passenger-carrying capacity? The fact is that most of the practical reasons adduced to show the propriety of using direct-current motors on this particular work apply *a fortiori* to using them instead of alternating motors on any work in which high efficiency, moderate weight and moderate cost are conspicuous virtues. The question of relative freedom from commutator troubles we need not here discuss, but the distances to be covered in this New York Central system are quite comparable with those involved in common electric roads, and if the extra weights and cost of alternating apparatus nearly or quite counterbalance any saving in copper here, why will they not produce a similar effect in cases where the multiplicity of cars increases the relative cost of motor equipment? We have rather a predilection for alternating current, but the arguments for the present brands of alternating commutating motors seem to get a bit shifty from time to time when they face actual competition.

Measuring Instrument Patent Decision.

The United States Circuit Court of Appeals sitting in New York City has handed down a decision reversing the decision of the lower circuit court in a suit involving the validity and infringement of two Weston electrical instrument patents. The parties to the suit were the Weston Electrical Instrument Company and the Keystone Electrical Instrument Company. The Weston patents in suit were reissued patent No. 11,250, granted June 28, 1892, and patent No. 470,340, granted March 8, 1892.

The contentions of the defendants, as stated by the court, were that Weston did not discover a single principle or solve a single problem in the art of measurement of alternating currents which had not already been so far worked out and published that no invention was required to overcome the alleged difficulties in the way of the practical application of the prior art, and that if invention was required for the practical solution of the alleged problem it was not disclosed by Weston. A patent granted November 1, 1897, to J. Cauderey for an electric dynamometer was cited as an anticipation.

In discussing the reissued patent the opinion states that it describes an instrument for measurement of alternating current differentiated from that of Cauderey in the details shown in a prior Weston patent, No. 392,367. The court held that the complainant had failed to point out any tangible or definite statement of invention by the patentee or any novel concrete creation in the construction of the patented device. In his brief he contradicts the theory of his expert, and states that "the invention is not a matter of electrical proportioning," but that it consists in a combination of parts constituting the concrete instrument. These parts, as defined by him in the argument, were, first, the closeness to the coil, but it does not appear that that was any closer than Cauderey. Second, positive pivots which held the point from sidewise movement; these are described both in Cauderey and Weston's prior patents. Third, springs, which are the same as those described in Weston's prior patent. Fourth, direct reading, which is shown in Fig. 4 of the Cauderey patent. The court held that the claims in suit of the reissued patent cannot be sustained because the description in the original patent fails to show that the invention covered by said claims was intended to be secured in the original patent.

Taking up the second patent in suit, it is stated that the improvement claimed consists in omitting the shellac paper from the movable coil of the reissued patent in suit, and in constructing it in its annular shape by winding the wire around a mandrel and cementing it together by means of an exterior coating of shellac. This construction reduces the weight of the movable coil, which was the stated object of the alleged invention. The court held that other prior publications disclose similarly constructed coils, different only in shape from that of the patent in suit in being rectangular with rounded corners. These prior constructions were designed for use in direct-current instruments, and the argument that it required invention to use such a coil "of any desired form" with an alternating current or to thus change the shape of the coil, cannot be sustained, especially as it does not appear that any different or new function was accomplished by reason of such use or change.

The decree of the lower court was reversed with costs and the cause remanded to that court with instructions to dismiss the bill. The circuit judges before whom the case was tried were Justices Wallace, Lacombe and Townsend.

Boston Rapid Transit Commission.

The annual report of the Boston Transit Commission for the year ending June 30, 1904, deals principally with the construction of the East Boston tunnel, which now is completed, and gives the plans of the Washington Street Subway. Nearly one-half of the report is an appendix containing an official report on the fatal accident August 10, 1903, in the subway in Paris, a list of employes in some of the Boston Transit Commission departments, lists of contractors and bids and the results of some tests with material entering into the construction of the subways and Elevated.

A detailed account of the actual work on the East Boston tunnel and the Subway, together with maps and illustrations, is given in the report by Howard A. Carson, the chief engineer of the commission. The financial statement shows that the net cost of the Subway on June 30, 1904, including alterations, was $4,134,758.05, and that the rental paid by the Boston Elevated for the year ending June 30 was $213,420.44. The rental for the first quarter of that year amounted to $53,354.31, as against $53,356.83 for the last quarter.

Two estates have been taken by the Boston Transit Commission for entrances to the Washington Street Subway. One is on Essex Street and the other is on Lagrange Street. The property numbered 15 Essex Street comprises a brick building containing a store on the lower floor and offices above. It is taxed for $64,400, of which $52,400 is on the 1,496 square feet of land and the remaining $12,000 on the building. The property 11 to 13 Lagrange Street is assessed for $21,000. The land contains 1,349 square feet, taxed for $15,000. The building is assessed for $6,000. There will be another entrance on Boylston Street, but the exact spot is not yet indicated by the commission. Washington Street will have no entrances or exits to cause congestion of traffic on that street; it has been the plan of the commission to build stations where the traffic is small and where no inconvenience can come to the general public from Subway passengers going to and from the Subway.

The Chicago Freight Subway.

The Chicago Subway Company, with a capital stock of $50,000,000, and composed of men who represent 90 per cent. of the railroads having Chicago terminals, was incorporated this week at Trenton, N. J., taking over the $30,000,000 company which has built fifteen miles of freight tunnels under the city streets. The vast tonnage of the railroads represented by the financiers in the new corporation will be diverted into the company's tunnels, which are already under every street in the business district of Chicago. Apparently in connection with this mammoth deal, Sir Ernest Cassel, the financial adviser of the King of England, has been in Chicago with Jacob Schiff, head of the international banking house of Kuhn, Loeb & Co., who is heavily interested.

Among the men who will enter the directory of the new corporation are Edward H. Harriman, the principal factor in the Union Pacific and the Southern Pacific and a big factor in the Alton and Illinois Central Railroads; James Stillman, president of the National City Bank of New York, and a factor in the control of a large number of great eastern and western systems, notably the Chicago & Northwestern and the Chicago, Milwaukee & St. Paul Railroads, and Jacob Schiff.

The Subway Company has taken over, it is announced officially, the entire stock of the Illinois Telephone Construction Company, 66⅔ per cent. of the stock of the $30,000,000 Illinois Tunnel Company, and stands ready to take over all the remaining stock of the tunnel company at the terms on which it acquired the two-thirds. The Illinois Company will remain the home operating corporation, but owned by the Chicago Subway Company of New Jersey. President Wheeler, of the Illinois Tunnel Company, will retain his present place. The deal guarantees the immediate use of the tunnels by the railroad interests concerned and promises speedy relief for Chicago from the present congestion in terminal roads and in the downtown district. At present the Illinois Tunnel Company has completed about fifteen miles of tunnels in downtown Chicago. The bores are 6½ ft. wide by 7½ ft. high, although in places the dimensions are 10 x 12 ft. The system has been fully described and illustrated in these pages. President A. G. Wheeler made the following statement:

"The tunnels finished under the streets to prove of great benefit to the community must have the traffic diverted from the streets and transported through the tunnels. While no question was ever in any one's mind that ultimately this would be accomplished, yet to have the community reap the benefit of the removal of such congestion at once it became necessary that the parties controlling the steam railroads, with terminals in Chicago, should be interested in the tunnels, and immediately use the tunnels for the transfer of the freight from the railroad terminals to the basements of the business houses. To produce this result and get the tunnels in full operation at the earliest date the holders of two-thirds of the stock of the Illinois Tunnel Company sold their stock to a corporation called the 'Chicago Subway Company,' this corporation being controlled by the owners of all of the steam railroads that terminate in Chicago. The Chicago Subway Company has no connection with, nor are any parties interested in it connected with the street railways of Chicago."

Electric Power Along Niagara Frontier.

PLANS are now under way for the development of more than 1,000,000 electrical hp with water between the Lake Erie and Lake Ontario levels. Of this total development 146,600 hp is represented by the present capacity of hydro-electric plants that are already in operation. Plants now under construction and at various stages of completion have been designed for an ultimate capacity of not less than 553,500 electrical hp, and plants for which franchises have been secured and real estate purchased, but on which actual construction work has not been started, will, it is said, add not less than 360,000 hp to these figures.

Of the five plants now in operation, three are in the city of Niagara Falls on the American side of the river, one is in Queen Victoria Park, Niagara Falls, Ont., and another is at the foot of the Niagara escarpment, about three miles from St. Catharines, in the same province. The two best known plants are those of the Niagara Falls Power Company, on the American bank of the river, which have a combined capacity of 105,000 hp. Farther down stream, on the same side and also within the city limits, is the station of the Niagara Falls Hydraulic Power & Manufacturing Company, with a capacity of 30,000 hp, in the electric generators there installed. Just across the river, in the park on the Canadian bank, is the water-driven plant of the International Railway Company, with a generator capacity of 3,600 hp, including the machine that is just going into position. The station of the Hamilton Cataract Power, Light & Traction Company, near St. Catharines, has a present operating capacity of 8,000 electrical hp, which brings the total rating of generators at the five stations between the Erie and Ontario Lake levels up to 146,600 hp, as above noted.

Turning to plants now under construction, the Canadian bank of the river, from a point just below the Horseshoe Falls to more than a mile upstream, is the scene of greatest activity. Along this stretch of park are ranged the partly completed plants of the Ontario Power Company, the Canadian Niagara Power Company and the Toronto & Niagara Power Company. The plans of these companies in the order named call for ultimate developments of not less than 180,000, 110,000 and 137,500 hp, respectively. Near these three great plants is that already mentioned of the International Railway Company, where provision has been made for the installation of additional units, aggregating 6,000 hp, as soon as they are wanted. At the plant above mentioned, near St. Catharines, an extension is under way that will add 40,000 hp to its present capacity.

Less new work is in progress on the American side of the falls, but the Niagara Falls Hydraulic Power & Manufacturing Company has started excavations for a new station of 80,000 hp capacity there. The six plants just mentioned as in progress of construction foot up the total of 553,500 hp, above named. It thus seems that the capacities of electric generators now operating with water from Lake Erie, plus the capacities of the machines required to complete the plants in progress of construction, amount to no less than 700,100 hp.

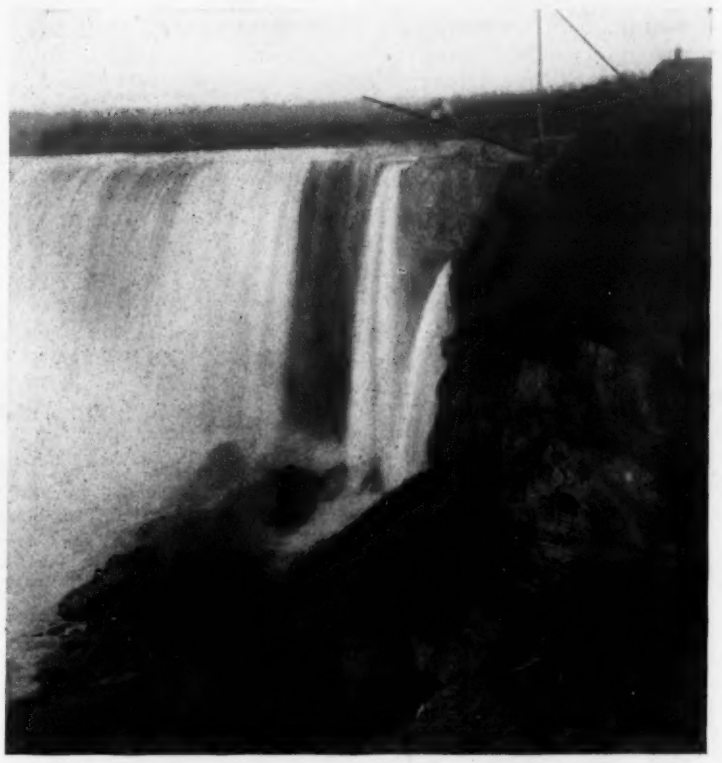


FIG. 2.—VIEW OF PORTAL, ONTARIO POWER COMPANY.

FIG. 1.—BIRD'S EYE VIEW OF NIAGARA FALLS, SHOWING INTAKE AND FOREBAY AND POWER HOUSE, ONTARIO POWER COMPANY.

One of the proposed plants at Niagara Falls is that of the Lower Niagara River Power Company, which contemplates the excavation of a tunnel from a point nearly beneath the Grand Trunk Railway bridge, at the head of the whirlpool rapids, to an indenture known as the Devil's Hole, in the American bank, about 8,000 ft. down stream. Love charter, granted by the New York Legislature in 1891. Under this charter the Niagara County Irrigation & Water Supply Company proposes to excavate a canal 37,550 ft. long from La Salle on the Niagara River, at the Lake Erie level, to the Devil's Hole, above mentioned, below the whirlpool rapids. This canal will lie mainly

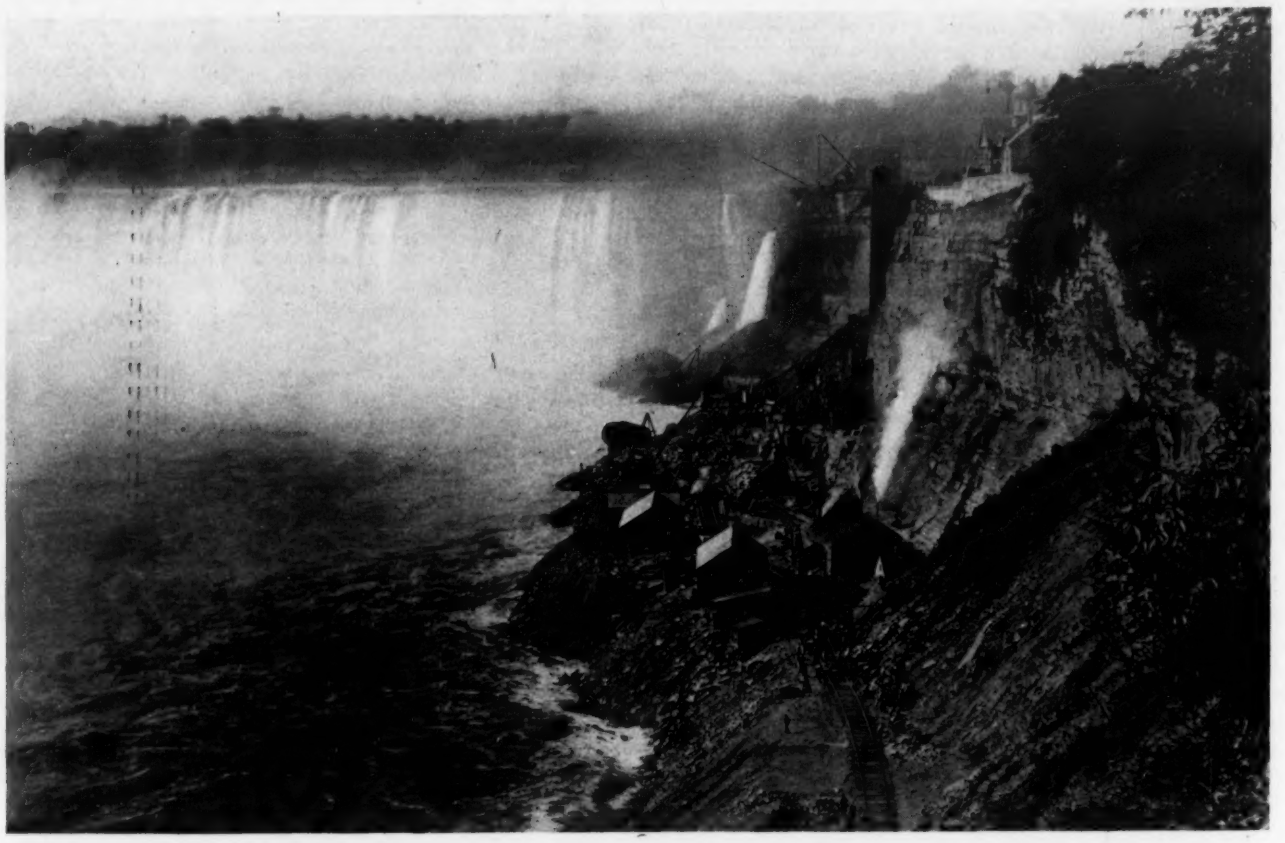


Fig. 3.—Site of Power House below Falls, Ontario Power Company.

Fig. 4.—Cascade near Intake of Toronto & Niagara Power Company.

The intake tunnel for this plant being below the falls will have no effect on them, and it is said that the volume of water to be carried by the tunnel will yield 200,000 hp at an available head of 82 ft., corresponding to a fall in the rapids. Another plan for the development of a large power plant at Niagara Falls rests on the so-called through rock, will have a width of 120 ft. at the bottom and will be 25 ft. deep below the water line. In the canal the slope of the bed will be such that water will flow through it with a velocity of 3.5 ft. per second, and it is said that this will yield enough water for the operation of 32 electric generators of 10,000 hp each. These

generators will be 11,000-volt, three-phase, 25-cycle machines, each direct-connected to turbine wheels on a horizontal shaft. It is expected that the station at the Devil's Hole, as at first built, will contain only 16 of these generators and will thus have an initial capacity of 160,000 hp. Condemnation proceedings covering a strip of land 500 ft. wide along the entire course of the proposed canal were begun on July 16, 1904, and it is said that excavation will be started at an early day.

The area in which the more than 1,000,000 hp promised at the falls is to be utilized is to a large extent uncertain. On the American side of the river, in the territory between and including Niagara Falls and Buffalo, substantially the entire outputs of the 105,000 hp capacity plants of the Niagara Falls Power Company, and of the Niagara Falls Hydraulic Power & Manufacturing Company, the latter rated at 30,000 hp, are now consumed. The International Railway lines absorb the entire development of energy at their 3,600-hp plant on the Canadian side, and it is probable that extensions of this plant will only be made to meet the railway requirements. Hamilton, Ont., requires the entire output of the 8,000-hp plant near St. Catharines for local electrical supply, but it is not certain that the 40,000 hp

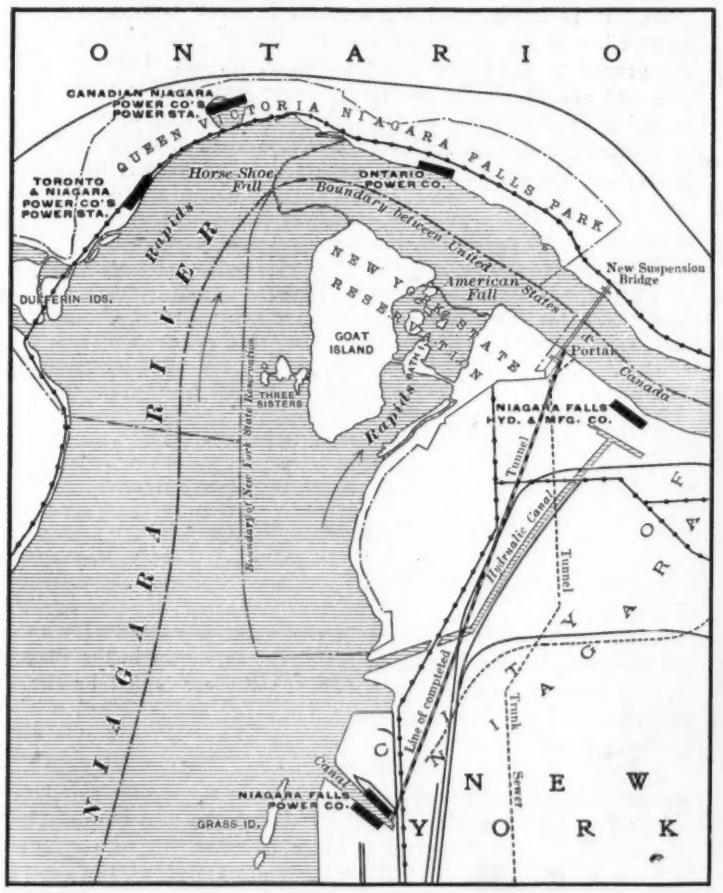


FIG. 5.—MAP OF NIAGARA FALLS, SHOWING LOCATION OF POWER STATIONS.

of capacity now being added to this plant can find a load in the same city. The Toronto & Niagara Power Company will no doubt find a large lighting and power load at the Canadian capital, but it may be doubted whether this will absorb all of the energy from the 137,500-hp plant now under construction. As to plans for the sale of energy from the 180,000-hp plant of the Ontario Power Company, nothing definite is know, but it seems to be a fair supposition that the lines of this company will run on both sides of the international boundary and to any distance warranted by commercial requirements and practicable voltages. From the 110,000-hp plant of the Canadian Niagara Power Company energy will no doubt go to the present and future connected loads of the Niagara Falls Power Company, with which the former is intimately associated, as well as to other points. The new 80,000-hp plant of the Niagara Falls Hydraulic Power & Manufacturing Company, the only one now under construction on the American side of the river, will naturally find its first loads close to those of the present station, and it is as yet unknown whether the policy of this company will lead to extensions of its lines much beyond the limits of its home city.

Thus far Buffalo has been the only large city to share in the benefits of Niagara power, but it seems certain that there will be a large overflow of power from Niagara Falls to other places when the plants now under construction there are completed. Around Niagara Falls there is some talk of much rate cutting and of extremely low prices for power that are to take place when the new plants are in operation. Conditions in the territory within striking distance of the falls, with transmission voltages now in daily use, do not seem to bear out such conclusions.

In the first place, it should be borne in mind that the great plants now under construction around Niagara Falls will not reach their ultimate capacities at once, but that after the hydraulic developments are completed the generating machinery will be added gradually during several years. Meantime the demand for power at the falls is rapidly increasing. But whatever the generating capacity of plants at the falls, it would seem that the rates for power there cannot remain less than the rates in other cities, within say 100 miles, by more than the cost of transmission, which is not great at that distance with present voltages. A great reduction in the rates for power at Niagara Falls would seem to imply similar reductions in a number of other cities.

Traction Systems of Paris.

BY PAUL DUBOIS.

PARIS is perhaps the city where the greatest variety of traction systems is to be seen. To handle the traffic of such a large city requires a great number of lines; and many of them continue for greater or less distances into the suburbs. Within recent years the suburban traffic has greatly increased, especially after the general adoption of the electric system. The authorities have never allowed the trolley to be used to any extent inside the city, so that this gave rise to a great number of different

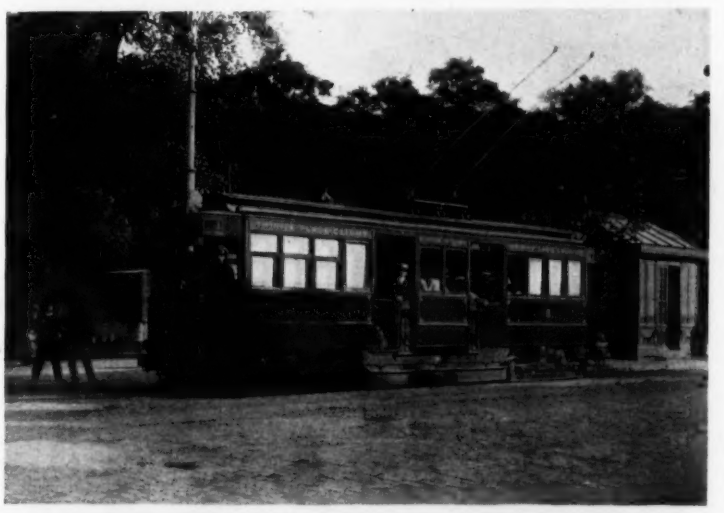


FIG. 1.—CLAIRET-VUILLEUMIER SURFACE CONTACT SYSTEM.

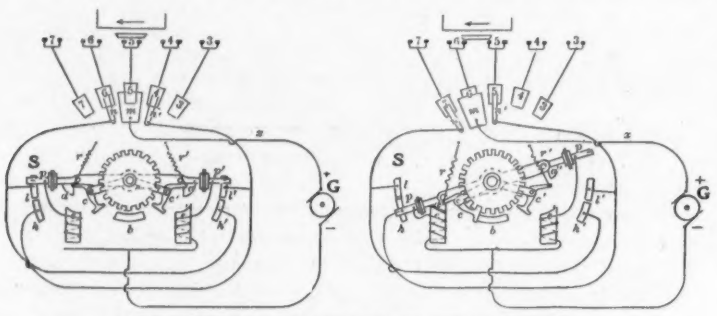
methods of operating the cars. The lines are controlled by many different companies, and each was free to choose its own method. This accounts for the great variety which is noticed in the lines which now cover the city. A considerable number of the lines were changed over from animal to traction power before the electric system had come into general use, so that at present these are using either compressed air or steam systems. Some of the latter run for long distances into the suburbs, using either double-decked cars or locomotives drawing trains made up of trailers.

As to the electric systems, which have now come extensively into use and are gradually driving out the other methods, some of the lines use accumulators and others the surface contact or underground conduit. Where the lines pass out of the city most of them change over to an overhead trolley road. This is carried out in many different ways, to suit the nature of the case. As it was desired to avoid transferring the passengers, different types of combination cars have been adopted which can run either in the city or in the suburbs. One line, for instance, uses a car containing accumulators, a conduit plow and a trolley. Others combine the surface contact with the trolley, raising up the contact rail when the

car reaches the suburbs. In another case the problem has been solved in a rather novel way by using a special form of accumulator locomotive which draws a train made up of trolley cars. The locomotive is disconnected at the suburbs when the train travels on the overhead system. Thus it is remarked that a great variety of systems are employed. Some of these will be illustrated in the present description.

CLAIRET-VUILLEUMIER SYSTEM.

The Clairet-Vuilleumier system uses surface contacts within the city and the trolley throughout the suburbs. The line starts from the central part of the city and runs through the northern suburbs to Engbien. Its total length is 5.2 miles. One of the cars is shown in Fig. 1. These cars are of handsome design; they are equipped with double trolley on account of the fact that they pass for part of the way over the tracks which were laid some years ago for a



FIGS. 2 AND 3.—DIAGRAMS OF RELAY DEVICE.

traction company which uses accumulator cars, and so the rails are not bonded. On this section the trolley line is run double. After leaving the section one of the poles is lowered and the car runs with one trolley as usual. The car has a long platform in the center with two separate doors for the first and second-class compartments.

The surface contact system which is used within the city limits is one of the few which are found to work satisfactorily, and it has been operating very regularly for several years past. The contact system is formed by placing a series of cast-iron surface-blocks along the track between the rails. The blocks are connected electrically in pairs. The car has a rail mounted underneath the truck which passes over the blocks and takes current for the motor. The pair of blocks which is under the car at any given moment receives current from the main cable (which is laid underground) by means of a distributing apparatus. To carry this out, each pair of blocks is connected by an underground wire with an automatic relay or revolving switch which sends the current into the blocks progressively as the car passes. Each relay is placed in a cement-lined cavity below the pavement which is covered by a manhole. The relays are placed along the pavement about 300 feet apart. The main cable runs alongside and at each cavity a branch runs offs into the relay. The latter is in turn connected by underground wires with 20 pairs of blocks.

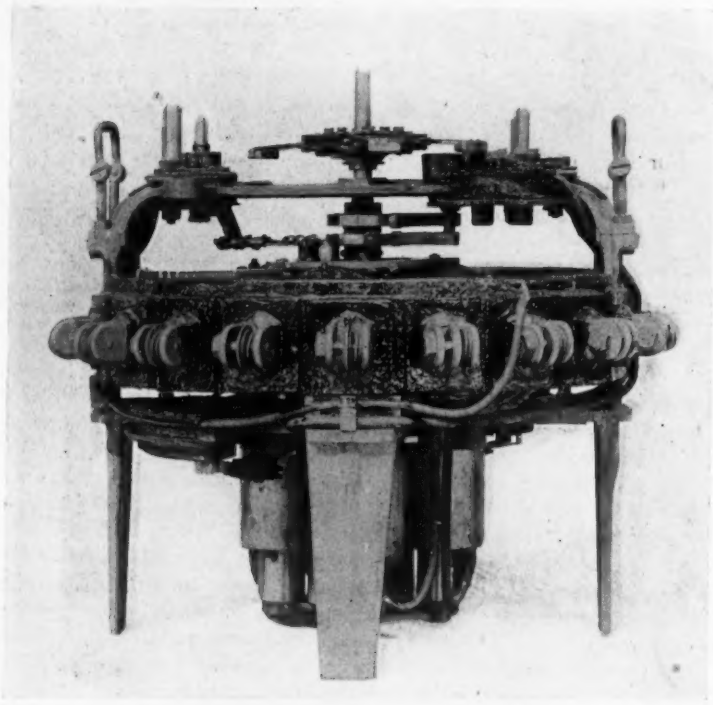


FIG. 4.—RELAY, CLAIRET-VUILLEUMIER SYSTEM.

The essential feature of the system is the relay device which shifts the current from one block to the next as the car passes. It has the form of a circular switch with 20 points, over which an arm is made to revolve by an electro-magnetic device. Its operation will be understood from Figs. 2 and 3, while Fig. 4 shows a side view of the apparatus. It consists of an iron frame which supports a circular plate in the center around which are placed the 20 contacts or switch plates. The frame supports a vertical shaft on which are mounted, first, a wheel carrying as many slots around its periphery as there are points in the switch; second, an arm which carries three switch plates, *n*, *m*, *n'*, which rest upon three consecutive points of the circle; third, a set of collecting rings which bring the current to the revolving part. The contact *m* serves to distribute the current which is received from the main cable. It is larger than the interval between two switch-points, so that it enters into contact with the following one before leaving the preceding. The two other plates, *n*, *n*, are placed on either side and are of smaller size; they leave one point entirely before engaging on the next. Each of them is connected by means of a commutating switch, *S*, with an electromagnet, *e*, whose other end is connected with the rails of the track. The magnet operates an

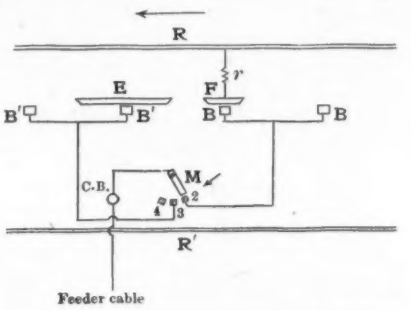


FIG. 5.—DIAGRAM OF CONNECTIONS OF SAFETY DEVICE.

armature of double-anchor form, which is solid with the commutating switch.

Each of the pairs of blocks in the street is connected with one of the 20 switch points around the circle, as shown in the diagram. In the position here indicated (Fig. 2) the car is fed by the pair of blocks No. 5. Supposing the car to move in the direction of the arrow, its rail forms a circuit between *m* and *n'*, and this causes current to pass in the electromagnet *e*. The magnet causes the armature to swing around to that side. On the armature is mounted an arm which carries a pawl, *c*. When the arm is attracted by the electro-magnet the pawl is made to enter one of the grooves of the slotted wheel and the rotary movement of the armature causes a corresponding movement of the wheel.

The central shaft thus rotates, carrying with it the switch-plate, *n*, *m*, *n'*, and the apparatus is now in the position shown in Fig. 3. Thus the switch-plates have advanced by one point respectively. In consequence, the main current is now sent from *m* to the pair of blocks No. 6. At the end of the movement the pawl *c* is stopped by the piece *b*, which limits its course and therefore the stroke of the revolving part. The apparatus remains in this position until the car has entirely left block No. 5, which has hitherto supplied it with current. At this moment the arm with its panel is drawn back by an opposing spring and the apparatus comes back to the former position.

As the car proceeds, the action is repeated and the revolving system advances by another 1-20th of a revolution. The electromagnet *e'*, seen on the opposite side of the apparatus, does not come into play here; it is used in case the car proceeds in the other direction, and in fact is rarely employed.

A safety device is carried below the car in order to prevent the rear blocks from remaining charged in case the apparatus should fail to work. This is shown in the diagram (Fig. 5). At *B B* is shown a pair of blocks and at *B'B'* the succeeding pair. The main contact rail of the car, *E*, has just left *B* and is now upon *B'*. Below is a part of the relay with three consecutive points, 2, 3, 4, and

the main current arm *M*. A smaller rail or bar, *r*, about 3 feet long is carried in the rear and on the same level as the large rail. It passes over the blocks and is now on block *B*. This rail is connected through a low resistance with the rails of the track. Between the main cable and the arm *M* is placed an automatic circuit-breaker, *C B*. As the car is now upon *B'*, the arm *M* should be upon point No. 3; but if it should have remained on No. 4, this would leave the surface-blocks *B B* charged. In this case, however, a heavy current passes from the small rail through the circuit-breaker, which cuts off the current from *M* and the car stops; in this case the apparatus is inspected.

The line is supplied with current at 500 volts from two large sub-stations which are located in the suburbs, each station feeding one-half the circuit. The sub-stations receive 5,000 volts alternating current from the large central station belonging to the Telephone Company. The current is first lowered by transformers to 380 volts, and then sent into two rotary converters, which deliver 550 volts direct current. A large storage battery of 270 cells is placed in parallel on the line.

DOLTER SYSTEM.

The Dolter system of surface contacts is used over a portion of line which passes through the Bois de Boulogne. As the trolley is not permitted on the section of road which crosses the park, the use of the surface contact became necessary. The present system was therefore adopted over this section, which is 2.8 miles in length, while the cars use the trolley upon the remainder of the line, which runs through the suburbs.

The present surface contact system is of the type which makes contact from the current cable to the block by a device which is contained within the block itself. The diagram (Fig. 6) shows the essential features of the apparatus. The block consists of two

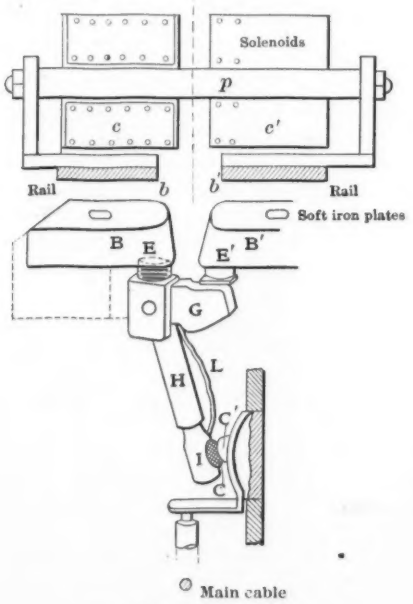


FIG. 6.—DOLTER SYSTEM.

heavy plates, *B, B'*, of soft iron, which are mounted opposite each other in a block of non-magnetic metal which serves to hold them together. Below the blocks is a movable contact piece which is formed of the soft iron armature, *G*, the insulated piece, *H*, and the metal piece, *I*. The part *G* is pivoted within the piece *E*, which is screwed into the upper plate. On the other side the corresponding block *B'* carries a projection *E'*, which comes opposite *G*. The latter piece thus forms the movable armature of the magnetic circuit, *B, G, B'*.

The circuit is completed when the car passes over the block. To carry this out the car is provided with a long contact rail which is formed of two iron bars, *b, b*, placed side by side with a small interval between them. The bars are held together by a number of horizontal soft iron pins, *p*, which are placed at intervals. Each of the pins carries a double solenoid, *C, C'*. When current passes in the solenoid the bars become magnetized, and when they pass over the block the circuit is completed through the bar and the iron parts of the block. This causes the armature *G* to be attracted against the piece *E'*. The contact piece *I* carries the current from the main cable (which runs under the block) to the contact rail on the car. This is carried out by two blocks of specially hard carbon, *C, C'*, one of which is fixed in the arm and the second attached against the lower part of the apparatus. A fuse-wire, *L*, connects the carbon *C* with *G*. The second carbon *C'* is mounted in a metal contact piece which receives the branch-wire from the cable.

In this way the current passes from the cable through the metal pieces *B, B'*, and through the rail into the motor on the car. The rails of the track are used for the return. The air-gap between *G* and *E* is only 2 millimetres. When the rail leaves the block the arm drops, and it is the next block which supplies the car, and so on. Owing to the high grade of carbon which is used, there is no difficulty with the contacts. One of the features of the Dolter system is the safety device which is employed. In the rear of the main rail is a smaller rail about 2 feet long. It is connected direct with the ground, so that in case the rear block should remain charged after the rail leaves it, the smaller rail would cause a short-circuit which blows the fuse *L* and throws the current off the block. It should be remarked that the magnetized rail is curved upward in the rear part and this rail comes upon the second block while the metal has left the first block, but there is sufficient magnetic attraction through the air-gap to hold on the rear carbon contact while the front contact is completed. The current is never broken at the carbons, and there is no sparking in consequence.

The rail on the car is 22 feet long, of which 85 per cent. is magnetized. The car travels at a speed of 15 miles an hour or 7 metres per second. Under these conditions the apparatus works quickly enough, as the current is cut off within 1-16 second. The distance between the surface blocks is 16 feet.

NOGENTAIS SYSTEM.

The city terminus of this extensive system of lines is at the Place de la Republique and it runs throughout the eastern suburbs over a considerable number of lines which cover a large district. It is a good example of the transformation and increase of the road which has been brought about by the electric system. The Nogentais Railroad Company, which was founded in 1884, operated a number of lines passing through the eastern suburbs. In 1888 the system reached a total length of 10 miles, and was operated entirely by compressed air. This method of traction offered many disadvantages, seeing that in case of extension the company was obliged to carry out a very expensive system of compressed air piping, or else establish several compressing stations, with a considerable number of charging points. Besides, the compressed air method proved very expensive to operate.

For this reason the company decided to effect a radical change in the method, and also to increase the number of lines considerably. Accordingly, in 1899 the transformation of the compressed-air lines to the electric system was commenced. This work was carried out by the Paris branch of the Thomson-Houston Co., and Mr. Garfield, one of its leading engineers, has furnished the following points about the electric lines. At the same time many new roads were installed to connect with the former, so that at present the total length of the lines in the city and eastern suburbs is more than 30 miles. The lines pass through about 20 different towns and villages, and the region is well populated. The traffic is considerable and is constantly on the increase. The accompanying map shows the extensive territory which is covered by the Nogentais lines.

The suburban system is connected with the city by a double track line which runs to the terminal station lying near the centre. This line runs in underground conduit from the fortifications over a length of 2 miles, and from thence to the terminus the traction is carried out by accumulators. The conduit system is of the Thomson-Houston lateral type. In order to operate the city and suburban system a special type of car was designed, while a second type is used exclusively for the suburban roads and employs the trolley alone. The first type, which is shown in Fig. 7, has been designed to use either trolley, underground conduit or accumulators, and can thus circulate within the city and in the suburbs. It is a double-decked car and measures about 35 feet long between buffers. It contains 78 places in all. The inner compartment is separated from the platform by sliding doors, and the platforms themselves are divided into two parts by a partition which forms the prolongation of the staircase which leads overhead. The partition serves to separate the motorman from the passengers on the

front platform and in the rear it separates the passengers mounting the staircase from those who pass inside the car. During the winter the upper deck is closed by movable glass panels.

The car body is supported on 2 double-axle trucks with 1.22 metres between axles and 3.87 metres space in the centre between trucks. The electric outfit comprises two T.-H. motors of 45 hp each, one on each truck. Within the city the car uses accumulators over the first section. The batteries are placed in a large case which is suspended below the car in the space between the trucks. The batteries are made up of "Union" cells, one of the leading Paris makes, and contain 210 cells weighing 18 kilos each. These

FIG. 7.—CAR BARN NOGENTAIS SYSTEM.

cells are placed in 6 compartments in the main case. The latter is supported by brackets upon two heavy angle-irons which run across on each side. The battery is charged in place and is not removed except for inspection or repairs. The charging is carried out from the trolley line, while the car is running through the suburbs. The duration of the charge does not exceed 20 minutes. These cars take one or more trailers. In the case of a train weighing 20 tons, it has sufficient power to run at a speed of 15 miles an hour on level track. The car also carries the plow for running over the conduit section.

The second form of car which is used in the suburbs exclusively is shown in Fig. 8. It resembles the former type on its general

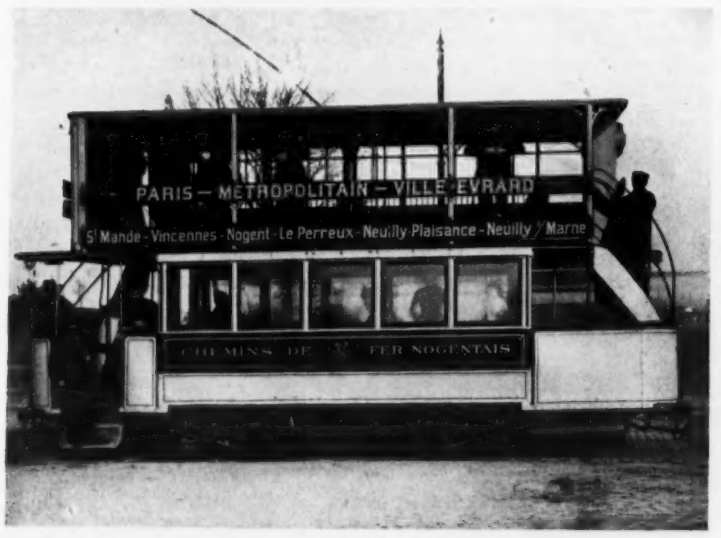

PARIS — METROPOLITAIN — VILLE EVRARD
St Mande - Vincennes - Nogent - Le Perreux - Neuilly-Plaisance - Neuilly / Marne
CHEMINS DE FER NOGENTAIS

FIG. 8.—TROLLEY CAR, NOGENTAIS SYSTEM.

lines, but is considerably smaller, having 52 places. The motor outfit is the same as before. It is used either with or without trailers. The Nogentais system of lines are now running as many as 130 cars in all. Current is supplied from a large station which is located in the suburbs. It contains 4 main generating units, two of 500 kilowatts and two of 325 kilowatts each. These machines, as well as the motors, have been built at the company's shops in Paris, under the direction of Mr. Edgar Mix, and are now running very successfully. A battery of accumulators is used in parallel on the line, according to the usual European practice. It consists of 220 large cells of the "Union" type, having a capacity of 400 ampere hours each, which can be raised to 600 by adding extra plates, should the operation of the line require it. The use of the battery is very efficient in keeping the voltage uniform, and gives a regular voltage of 450 upon the part of the line where the battery is located, or about 5 miles from the city. The accompanying curves, Fig. 9, will show at a glance the variations of voltage which occur in the line with and without the battery in parallel on the generators.

MALAKOFF-LES HALLES.

Another city and suburban line which uses a combination car is

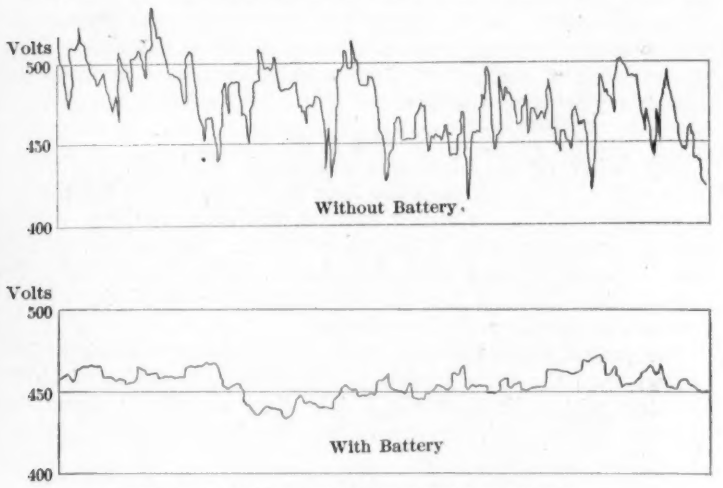


FIG. 9.—VOLTAGE CURVES NOGENTAIS SYSTEM.

the Malakoff-Les Halles, which runs from the city terminus at the Central Market to the suburb of Malakoff; from this point it will no doubt be extended in the future. This is one of the most recent lines. The total distance at present is 4.2 miles, or 3.6 miles within the city and 0.6 in the suburbs. The traction is carried out by accumulators inside the city, and the car is changed over to trolley on passing the gates. The accumulators are charged from the trolley circuit *en route*. In its general disposition this car closely resembles the preceding type and has practically the same electrical equipment. At present there about about 25 cars circulating over the section. This car is illustrated below (Fig. 10). It is double-decked and contains 60 places in all, 20 seated in the lower compartment, 26 on the upper deck and 14 on the platforms. The battery of the "Union" type is mounted as before in a central

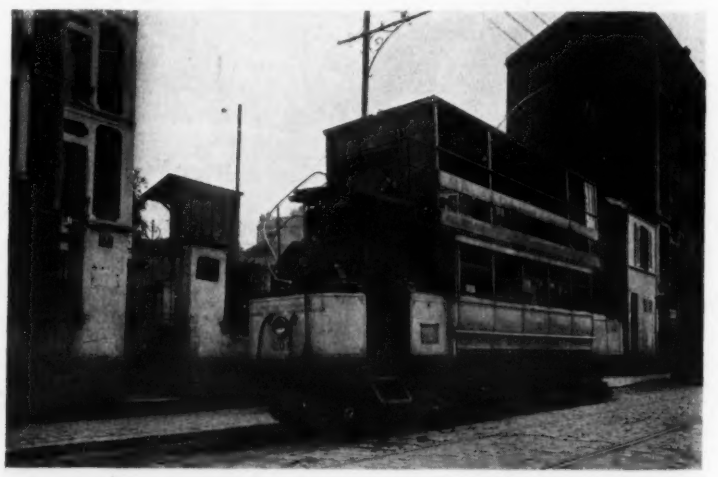


FIG. 10.—MALAKOFF-LES HALLES CAR.

box. In the present car it consists of 210 cells weighing 36 kilos each. Its capacity is 45 ampere hours. The Union cells have proved very satisfactory for this kind of work. In spite of a winter service which is sometimes very severe and an output which may reach as high as 200 amperes on starting up certain grades in the city, no serious accidents have occurred, and the insulation is always superior to 100,000 ohms.

The Malakoff line is supplied from a large central station which has been laid out for 2,500 horse power, as it furnishes current for two other traction lines on about the same system. The station contains three 500-kilowatt generators and one of 70 kilowatts; the main generators are driven by horizontal compound engines of 840 hp.

PARIS-ARPAJON LINE.

The problem of a combined system of city and long-distance suburban traction has been solved in a somewhat unusual way by the Companie du Chemin de Per de Paris-Arpajon. The line starts from the Odeon, in the city, and then runs through the southern part and from thence to the suburbs, over a total distance of 19

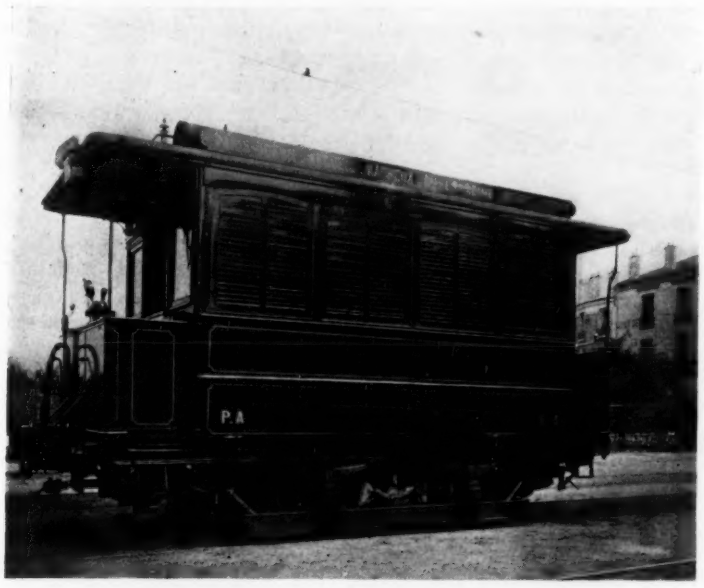


FIG. 11.—ACCUMULATOR CAR, PARIS-ARPAJON LINE.

miles. It was designed in the first place to run rather heavy trains made up of several long cars into the suburbs, and compressed-air locomotives were used for this purpose. After the system had been running for some time it was found that it would be preferable to sub-divide the large units and to run lighter trains at more frequent intervals. This would naturally be best carried out by the electric system, but as the trolley was not allowed within the city, the matter became complicated. After some consideration, the company decided to adopt a system of accumulator locomotives within the city, combined with a certain number of trailers which formed the train. However, the trailers themselves are provided with motor and trolley. When running within the city the electric locomotive takes a train of two or three trailers. In this case the trolley is lowered and the locomotive draws the whole train upon an ordinary track.

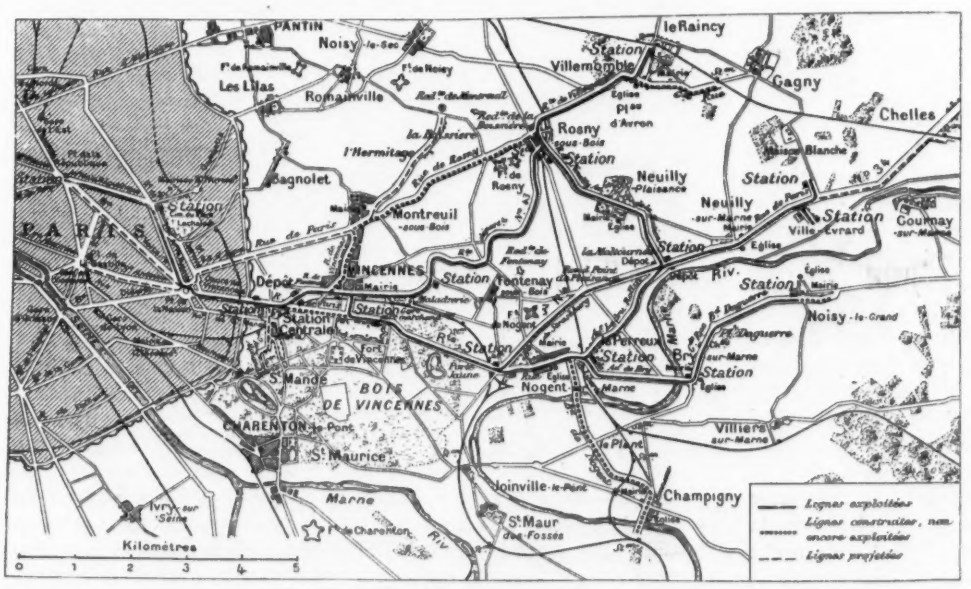


FIG. 12.—MAP SHOWING PARIS SUBURBAN TRACTION LINES.

On arriving at the city limits the locomotive is uncoupled from the train, when the trolley cars run into the suburbs on the usual overhead system. At the same time the compressed-air trains were used for the heavier trains, which traveled over the longest distances. At present, however, the electric system has proved such a success that it will not be long before it is used on all the trains of the line, and the compressed-air system abandoned.

The electric locomotive which is used on the Paris-Arpajon system is shown in Fig. 1. It is mounted upon a simple 2-axle truck. A motor of 50 hp of the Schuckert pattern is placed on each axle. The space within the locomotive has been fitted out so as to contain the accumulators, which consist of Tudor cells, giving a net capacity of 150 ampere hours. The cells are placed in a single tier upon the floor of the car. The interior is divided into 8 compartments or tanks, which are lined with lead and have drain pipes which pass underneath the car. The cells are contained in wood cases which fit into the compartments, counting 28 to 32 cells per case. The latter are well insulated and are separated from each other.

The locomotives are re-charged after each trip in order to keep them up to the proper point. At the station (which lies just outside the city) is a charging switchboard to which the locomotives are connected by a cable without disturbing the cells, which remain permanently in place. The locomotive carries two socket terminals at one end, into which the two ends of the cables are fitted. At the other end the cables carry charging plugs which are fitted into sockets on the switchboard. As the voltage of 650, which is reached when the battery is fully charged, is too high to commence the charging, the switchboard is provided with a rheostat which cuts down the charging voltage and adjusts it to the right point throughout the operation. It generally takes about 15 minutes to charge the battery. The locomotives are equipped with Soulerin air brakes, and a long, cylindrical air reservoir is mounted on the roof. A controller of the usual traction type is mounted on each platform.

A train drawn by an electric locomotive will be observed in Fig. *B*. The trailers which are shown here are of the new type which has been recently built. They are divided into two compartments with a platform in the center. The cars are mounted on a double truck and each truck carries a 50-hp motor. A system of switches connects the battery of the locomotive with the motors on the cars in case of accident to the motors of the locomotive. The new trailers are fitted with Westinghouse air-brakes.

Current for the line is furnished from the generating station which is combined with the compressed air plant under the direction of M. Redon. It contains four Babcock & Wilcox boilers. The dynamo room has two upright direct-coupled groups, using 330-hp engines operated at 120 revolutions. The dynamos are of the Schuckert pattern, constructed in France by Daydé & Pillé, of Creil.

Western Society of Engineers.

The next meeting of the Electrical Section of the Western Society of Engineers, instead of being held December 9, as previously announced, is to be held December 16, at the society's rooms in the Monadnock Building, Chicago. Prof. Henry Crew, of Northwestern University, will lecture on "Modern Theories of Electric Arc and Spark." The last meeting, which drew out a large attendance, was held November 11, when Mr. Samuel G. McMeen presented a paper illustrated with lantern slides on "Some Interesting Phases of Long-Distance Telephony." He took up simultaneous telegraphy and telephony, the limiting factors in talking over the longest lines, and the commercial inter-relations of local and long-distance lines.

The Telephone in War.

A recent dispatch from Mukden, Manchuria, says: "Some Russian officers have advanced with telephones to the trenches, and even beyond them, thence giving orders how to fire."

The Induction Motor With High Resistance Secondary.

BY C. J. SPENCER.

INDUCTION motors may be divided into two general types, namely, those with wound secondary and those having the squirrel cage type of secondary. The first type is usually provided with a controller designed to insert resistance when starting and to diminish the same as the speed increases. The second type is usually provided with a transformer having one or more taps, to which connections are made for starting at a reduced voltage.

Ordinarily, the squirrel cage type of motor requires a large current and exerts a small torque at standstill. The torque increases as the motor speeds up and reaches a maximum at about 80 per cent. of synchronous speed. If the connectors at the ends of the squirrel cage winding be made of an alloy having a sufficiently high resistance, then the speed, torque, current characteristic will be so changed that the maximum torque occurs at standstill and the current drawn from the line will not be excessive even though full voltage be applied direct to the primary. This same result can be obtained by applying a voltage lower than normal to an induction motor having a low resistance secondary, provided the air-gap be small enough. The small air-gap is, however, objectionable for mechanical reasons.

The induction motor with high resistance secondary is not new, but as the efficiency is low there is a reluctance on the part of manufacturers to supply them. The object of this article is to define certain special cases where the installation of such a type of motor is desirable.

Locomotive coaling stations are usually equipped with a winch head for hauling coal cars to and from the coal chute, after the locomotive has been detached. These shifts amount to a matter of about one car length and the only power required is for starting the cars. The method of procedure is to start the motor and winch head machinery, then to attach one end of a manila rope to the car and wrap a few turns of the other end of the rope around the winch head. Owing to the inertia of the heavy car one of two things must happen—the rope must slip on the winch head or the motor must come to a standstill momentarily. The rope will soon wear away if allowed to slip and the ordinary motor will draw an excessive current if brought to too low a speed.

In the case in mind a motor was supplied with the wound secondary, collector rings, controller and external resistance. The motor itself was designed for constant speed and the resistance for starting only. This would have been a satisfactory arrangement if there had been two men, one to hold the rope while the other operated the controller, or the controller could have been set at an intermediate point with the desired resistance constantly in circuit, but even if the motor had performed its work properly, the collector rings were objectionable. Coal will give off a gas which is combustible and any sparking such as that at these collector rings is a dangerous fire risk.

The results obtained with the above installation were not satisfactory. The motor would not slow down and, if the rope did not slip enough to give the car an initial movement, an excessive current would be drawn from the line. The station finally caught fire and was completely consumed, though the cause of the fire was not due to sparks from the motor. The station is to be rebuilt and the writer is endeavoring to have installed an induction motor with high resistance secondary, with maximum torque at standstill, and without collector rings or starting devices of any kind.

Such a motor admits of the roughest usage. The full voltage of the line may be thrown on the primary at starting and any load may be put on the motor without injury, provided, of course, that the high resistance rotor has a large cooling surface. If the motor has enough torque to start the load it will operate at some speed; if the torque is not sufficient, as would be the case if the car brake were on, the motor will not be injured, as it cannot take any more current than the secondary resistance will allow. Moreover, the torque required to start a car from standstill immediately up to full speed is very much greater than that required to move the car slowly at first and gradually to a higher speed. This is the difference between the two motors; one jerks the car, the other pulls it.

Another case is that of an ice hoist operated by a direct-current, compound-wound motor. The direct-current motor is to be replaced by an alternating-current machine, due to a change in the power supply. The motor is connected to a cable drum by a friction clutch, while there is a pair of ice tongs on the free end of the cable. The method of operation is to clasp the tongs on to a block of ice and throw in the friction clutch, while the motor is operating. It takes too much time to start the motor for each lift, besides which the inertia of the motor is an assistance in lifting the load if operated in this way, while if the motor were started from rest considerable power would be required to start the motor itself. This operated fairly well with the compound-wound, direct-current motor and an alternating-current motor with similar speed torque characteristics should be supplied for this work, i. e., the induction motor with high resistance secondary.

Citing one more case, that of a coaling plant where the coal is raised in grab buckets. It was deemed necessary to install a motor-generator and convert the alternating current into direct current for this work.

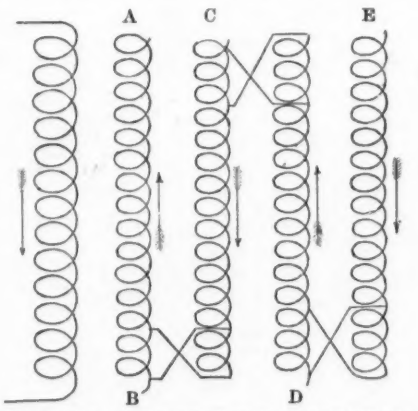
The above installations have the one general requirement, which is that the work consists of acceleration only. Direct-current influence has led engineers to look on a controller and rheostats as a necessary part of equipments, especially when the work is similar to the above, and this influence has extended to alternating-current motors. An induction motor with high resistance secondary is in itself a motor, controller and rheostat. It cannot be injured by excessive current; it always starts with the same acceleration, and it has as high a starting efficiency as any motor. A shunt-wound motor with a resistance permanently connected in the armature circuit has a speed, torque, current characteristic very much the same as required, with the difference that current can flow through the armature before the field builds up, while in the induction motor the field is formed before current is induced in the secondary. Therefore, the first rush of current is less with the alternating-current motor, assuming the average current to be the same.

The objections to the induction motor with high resistance secondary are low efficiency, high rate of heating and poor speed regulation. These all apply when the work requires a constant-speed motor, but when the work consists of acceleration only then this motor is the proper one to install.

Transformers in Series for High-Tensions.

In a letter addressed to the editor of the Russian paper, *Electritchestvo,* Mr. P. Kovalef makes the following statement as to a means of obtaining high-tension current by a new method of employing several ordinary transformers:

It is sometimes desirable to obtain a much higher voltage than that for which transformers at hand have been calculated. To that



DIAGRAMS OF TRANSFORMER CONNECTIONS.

end, the secondary wires of two or more transformers are generally connected in parallel with a source of low voltage, while the primary wires are connected in series. This manner of connecting, however, involves a high-potential difference inside the separate transformers, between the high and low-tension coils, and therefore it becomes a matter of risk to connect in series more than three transformers in order to obtain a voltage more than three times as high as the normal voltage of a transformer of a given type. The following connection of transformers gives a possibility of reaching much higher voltages:

The low-tension winding of only one transformer is connected to the source of e.m.f., and the primary windings of the remaining transformers are left free, connections being established among the high-tension windings. Shunts are taken from these windings at equal distances from the end of each winding, say at one-sixth

the total length. The manner of making these connections is shown in the accompanying figure. The second transformer is fed by the first, the third by the second and so on.

It can easily be seen that, notwithstanding the number of transformers connected in circuit, the inside tension in each of them will not exceed the tension between the extreme points of the winding, while the total tension of the whole circuit will be equal to the geometrical sum of voltage of all the transformers, considering, of course, the tension between the points *B* and *C*, *C* and *D*, *D* and *E*, etc.

Unfortunately, the question of voltage obtainable often becomes more complicated due to the self-induction of the transformers, and the total sum of voltages differs greatly from their algebraic sum. The above method may also be modified by using the secondary wires of the transformer.

Lightning Rods, Wireless Telegraphy and the Dispersion of Fogs by Electricity.

By A. Frederick Collins.

THE aerial wire which has played so important a part in serving as a guard against lightning and as a radiator and antenna in wireless telegraphy is destined to assume another and quite as clever a rôle in the new art of the dispersion of fogs by electricity.

While the record of past events concerning the extension of a wire perpendicular to the surface of the earth, having its base grounded, its opposite end elevated several meters above and terminating in free air, are for the first two purposes just cited well known, yet a short review of these processes will form admirable comparisons with the one to be described.

The theoretical considerations involved in the action of the lightning rod make it an easy matter to understand its relation to the phenomena of dissipating the electrically charged atmosphere, at least in its immediate neighborhood, and this with the practical evidence based on its use for the past 150 years, has rendered it a thing of exceeding simplicity and one no longer necessary to conjure with.

Not so with aerials employed in wireless telegraphy, for certain factors yet remain unknown, as, for instance, the earth; as a consequence the laws relating to the function of the grounded wire are not so well comprehended, although the fundamental facts of electric wave propagation upon which the art is founded are clearly enough elucidated, but the subject in its entirety is much more complicated, while its period of development has been limited to the last few years.

Wireless telegraph operators are often confronted during the passage of a thunderstorm with innumerable sparks of greater or lesser intensity, jumping from one wire to another wherever the proximity is such that a short gap may be presented, assuming the aerial switch is left closed. This result is not caused by lightning actually striking the aerial, but is merely due to the accumulation of a charge of atmospheric electricity on the wire, and since this is always of the opposite sign to that of the earth immediately beneath on the grounded terminal, the two charges manifesting a difference of potential equal sometimes to a pressure of a hundred thousand volts or more.

While all this may be interesting it is not new, for Franklin deduced this conclusion in 1749 and demonstrated it by actual experiment in 1752 when by a resorting to a very simple, original but withal ingenious expedient, which consisted of elevating a conductor by means of a kite he was enabled to identify lightning with electricity.

Franklin's kite and the ones used in field operations when sending and receiving wireless messages were constructed on somewhat different lines, yet both have points in common, in that they fly and that they serve admirably the purpose for which they were intended. Franklin's kite was made of a couple of cross-sticks covered with a silk handkerchief instead of paper, so that it would easily withstand the action of the rain upon it. To the vertical stick was fastened a metal point for the accumulator of electricity. The learned doctor attached to this a hempen string and to the lower end he tied a brass key; finally from the key a cord of silk was led and secured to a stake driven in the earth.

These little arrangements may be taken to indicate the philosophic turn of the doctor's mind. The tailless kite had not yet been invented, but the silken kite with its long tail did not detract in the least from the successful issue of the test. Aluminum had not been discovered and any other kind of a wire would have been too heavy; the alternative was a hempen cord, which when wet would, as Franklin knew, conduct the high-tension energy without appreciable resistance.

The key would serve as a small capacity area, while the silk cord was brought into the scheme to prevent leakage from the key to the earth. With this arrangement America's first electrician was enabled repeatedly to draw sparks from the key with his knuckle, to charge a Léyden jar and prove by many other essays that lightning, produced by the electrically charged atmosphere, was exactly the same as that induced by a frictional machine. This being so, it was evident to the rare mind of Franklin that a heavy wire projecting above the highest peak of a house or mounted on the top of a church spire would serve to dissipate the charge by providing the positive and negative electricities with a path of little resistance for the equalization of their potential differences and thus prevent disruptive discharges between the upper atmosphere and the earth via the intervening building.

The lightning rod, or lightning guard, as the English term it, was the result of this generalization and has furnished protection for millions of houses from the terrific results of atmospheric disruptive discharges; wherever civilization attains there one may also observe the lightning rod with its metal terminals reaching for the charge which it is to render harmless.

The functions of wireless telegraph aerials are different from those of the lightning rod and again the specific operation of the sending and receiving wires of an electric wave system are diametrically opposed though the arrangement is such that the wires themselves remain uncharged; as an illustration of the points in question, imagine the radiating wire of a sending apparatus; in its earliest form it was divided at a point near the earth and the spark-gap of a high-tension machine or coil was here inserted.

Now, instead of desiring the discharge of the upper and lower portions of the conductor, as in the case of the lightning rod, and so neutralizing the energy of the two capacities represented by a portion of the air surrounding the free end of the wire and the earth in the immediate neighborhood of the grounded terminal, the needful thing was to charge these two capacities to a potential where they would break down an air-gap, the surging energy taking the form of a spark and giving to the discharge an oscillatory movement which in turn sets up a disturbance in the ether as electric waves.

In receiving the emitted electric waves by the same or a similar aerial wire, now termed for convenience the antenna, the energy pent up in a spherical ether wave when it impinges upon the former would be neutralized instantaneously and without indication if the aerial were in the form of a continuous conductor like a lightning rod and its action would be the same to all intents as in the equalization of atmospheric electricity.

The difference between the antenna and the lightning rod is the insertion of a wave detector in the former causing the received energy to assume an oscillatory character through the system. While Hertz ascertained these facts with experimental radiators and resonators, it must be assumed that Popoff grasped the importance of these prevailing conditions in the application of his wireless meteorological indicator and likewise that Marconi was cognizant of them when he found that an earthed terminal and increased elevation of his sending aerial assisted largely in increasing the effective range of his instruments.

The investigations of Slaby in respect to the earthed terminals of the sending and receiving wires are interesting in this connection, for he ascertained that either the radiator or antenna could be a continuous conductor if it were provided at the point at which it entered the earth, if he joined another wire of equal length, leading it to the spark-gap or coherer; if the length of the straight vertical aerial conductor was one-fourth the wave length emitted by the closed circuit thus formed and the subsidiary wire was of equal length to the vertical aerial, then a nodal point of the system would be formed at the juncture of these wires with the earth.

Lodge's results are now in order. He, with the assistance of the British physicist, Clark, repeated a series of simple but remarkable experiments made by Lyndall as early as 1870 relating to the phenomena of dust-laden air and its dispersion by means of a red-hot body. Lyndall evolved a hypothesis to account for this action based on the assumption that the air was projected in convection currents at a higher velocity than the dust held in suspension in it which was naturally retarded.

This hypothesis did not entirely fulfil all the requirements for dust

of all kinds, whether of organic or inorganic origin, is similarly affected. In 1880 Lord Rayleigh made some observations that had a bearing on the subject in question, showing that ice held under the dusty air had an effect similar to a red-hot poker held over it, and that the dust-free space was as prominent in the one as in the other experiment.

Another observation made by Rayleigh, but one which seemed to have little connection at the time with those just mentioned, was the effect of an electrified body on water jets; it was clearly evident that an electrified stick of sealing wax held near the jet at the point where it broke into drops sufficed to cause the more minute particles in the form of mist, to cohere and fall in very large globules of water.

Three years later Lodge and Clark began the work of sifting these experiments in an effort to account for the dispersion of dust in a logical manner, with the result that they finally concluded that the dust-free space, whatever the nature of the particles, was caused by an electrical bombardment of the minutely segregated substances.

In these essays the red-hot poker and portion of ice were discarded and instead a metallic electrode charged to a few hundred volts was used; when plunged into dusty air it had an identical though not nearly so prominent effect as the former, yet the action of high and low temperatures and electric charges were similar. These operations were conducted in free air and the next step was to enclose the dust-laden air in a box or bell jar; terminals were provided so that they extended into the interior of the vessel and these were connected to the poles of a high-tension apparatus such as a static electric machine.

It was now possible to obtain a potential difference of many thousand volts and when the terminals were separated just beyond the striking distance a brush discharge occurred which produced an action that was indeed surprising, for the dust held in suspension was instantly precipitated, leaving the air clear and pure.

Not only was dust dispelled in this manner, but all kinds of smoke and fumes succumbed to the process just as easily. It was likewise ascertained that the positive charge was the most effectual in its action and in some of the experiments the negative terminal was placed in a position appositely disposed to the positive and in others the negative pole was connected to the earth.

By thus changing the terminals and their relative positions and by employing vapors and dusts of different substances, varying phenomena were obtained; by way of illustration, when dust of magnesium was subjected to the electrification process minute portions became charged to the opposite signs and in consequence were attracted to each other with considerable energy, forming little spheres and these acquiring like charges were repelled, causing them to strike the sides of the bell jar.

Cause and effect such as the above led the physicist to take up the matter of fog and fume expellation, which he recently carried out at the University of Birmingham, England. The arrangements for these trials were on a much larger scale than any before attempted, yet withal exceedingly simple, resembling quite closely the sending equipment of a wireless telegraph station. It consisted of a wire suspended in the air from a staff on the roof of the University, the upper end terminating in a number of points radiating in every direction; the base of this wire, which was carefully insulated, was attached to the prime or positive knob of a large static machine; the negative knob was connected with the earth by means of an insulated wire.

When the machine was set into motion a potential difference of perhaps a million volts was established and could be maintained between the free end of the aerial and the earthed terminal of the system. On making a practical test of the theory of defogging the atmosphere by means of the above apparatus it was found that the fog was easily dispersed and the air cleared for a distance of 150 to 250 ft. around the elevated points for as long a period as the machine was in operation. When the machine was stopped the fog, of course, quickly filled in the cleared space.

Several years ago Lodge designed an apparatus for use in large industrial works where dust and fumes predominated. In nearly all factories there is to be found suspended in the air either fine dust or fumes which are highly poisonous; again, some of these contain products of exceeding value when they are precipitated. In flour mills and coal mines the dust is dangerously explosive and in copper and arsenic works it is at once both poisonous and valuable. In some of the lead smelting works the lives of the workers are endangered by the fumes which escape with the smoke from the smelting furnaces, and Lodge has applied to these the electrical process of condensation on a comparatively large scale.

These various and numerous trials having proved successful, Lodge sought to extend the results to out-of-door practice. His idea crystallized in a scheme for dispelling fog on the Mersey River. This would, of course, necessitate much more efficient methods for generating high potential differences than the static or other influence machines. It is well known that in wireless telegraph emitters high potentials alone do not suffice in sending out effective radiations, but that current is also essential. For this reason induction coils have their secondaries wound with much shorter and thicker wire than in the ordinary types heretofore made, so that while the voltage at the terminals is reduced somewhat the input in amperes is increased.

Similar conditions are required in the dispersion of fogs on a commercial basis. But the difference between an emitter used in wireless telegraphy and a disperser for fog precipitation is that in the former a disruptive discharge is employed for setting up in the radiator system currents that are oscillatory in character, while in the latter there is no spark-gap and therefore the complementary sides of the system, i. e., the aerial and grounded terminal, do not change in polarity, but serves to ionize the foggy air by projecting streams of electricity into it of a given sign.

The designer suggests that for this purpose a Cooper Hewitt rectifier be connected with the secondary terminals of a transformer one side of which leads to the aerial and the opposite side to earth, the transformer receiving its initial energy from an alternating-current generator of suitable size; in this manner a current of any desired amperage and any voltage may be obtained.

Lodge has pointed out that the same process of electrification may be extended to the art of rain-making; in exceedingly dry countries aerial wires of aluminum may be attached to a balloon or kite and elevated to a point where it will come in contact with the watery particles of a passing cloud, when the discharge of electricity into it will cause the floating particles of vapor to coalesce and fall in the form of rain.

The vertical wire in the air, grounded at its base, has served mankind well since Franklin first indicated a use for it and it is now doing great work in wireless telegraphy, but it may be destined to fulfill even a greater mission in the dispersion of fogs and the production of rain. Dispelling fogs on rivers and around ships may be near at hand, since it has already been accomplished; the procedure for making rain has been pointed out, but is as yet a little in the future; after the realization of this a perpetual supply of "pure electricity," "milked from the ether" by means of a high aerial wire, will be in order.

Notes on the Cost of Power in a Railway Plant.

By H. S. KNOWLTON.

The cost of power is a problem of never ending interest to the railway manager, who keeps an eye upon the variations in operating expenses which each year exhibits. While it has been truthfully said that power is about the cheapest thing which an electric road has, this in no way justifies its waste or excuses failure to study the economies of its generation and distribution. The presentation of actual operating figures, therefore, needs no other justification than the importance of the subject.

The plant under consideration has been in operation not far from two years, and it supplies power to a Western city of some 40,000 to 50,000 people, including suburban communities lying within five miles of the city proper. About 70 cars are owned by the railway company, perhaps 30 of these being double-trucked, with a seating capacity of 75 passengers, four 38-hp motors being the usual equipment per car. About 25 cars are operated during the winter months and in the summer season this number is increased frequently to 50 or 60. The routes of the cars are, on the whole, level within the city proper, and characterized by few heavy grades outside; the country being neither extremely hilly nor very flat. A casual glance at the feeder system betrays no parsimony in copper investment on the part of the management, and the track has the reputation of being well bonded.

Perhaps the most striking feature of the plant is its use of non-condensing, single-cylinder engines. Artesian well water has never

been found in this part of the country, the water supply from driven wells being too hard for use in the boilers. Consequently water is purchased from the city, at a cost of about $3 per day. Most of the coal burned is lignite, which is dumped from the company's own cars into the bins at a cost of $1 per ton, approximately. Bituminous coal costing $2 per ton is used to a limited extent.

The power plant, a steam generating equipment, is composed of four 300-hp boilers, and two 400-hp boilers, all being of the Cahall-B. & W. water tube type. Natural draft is used, the stack being of steel 150 ft. high, with an added length of 30 ft. of concrete at its lower end. The inside diameter is 10 ft. throughout most of the height. A link-belt conveyor handles the coal between the dumping bins and the pockets above the boiler room floor. Hand firing is used and the feed water is heated by exhaust steam, which passes into a 5,000-hp Cochrane heater before being discharged into the atmosphere. The piping is wrapped with insulating covering; the boiler pressure is run from 120 to 140 pounds, according to the load requirements, and the drop in steam pressure between the boilers and the engine cylinders is 5 pounds. There is room for the installation of new boilers in addition to the 2,000 hp now in service.

The engine equipment aggregates four Allis-Chalmers machines, each direct-connected to a General Electric generator. There are two 500-kw units, each composed of a horizontal, single-cylinder, non-condensing engine, cylinders 28 in. x 48 in., direct-coupled to a 10-pole, 525-575-volt dynamo making 90 r.p.m. The third machine is a 300-kw, direct-current generator driven by a horizontal, single-cylinder engine at 100 r.p.m., the cylinder being 22 in. x 42 in. in diameter and stroke. The fourth unit is an alternator of 300 kw capacity, General Electric, revolving-field type, 6,600 volts, three-phase, 60 cycles, 72 poles, driven by a horizontal, cross-compound, non-condensing engine, cylinders 18 in. x 32 in. x 42 in. The normal or full load output of the plant is, therefore, 1,600 kw, of which 1,300 kw is direct current. The exciter set is a six-pole, 35-kw, 125-volt generator, driven by a steeple type compound, non-condensing General Electric marine engine, cylinders 7½ in. x 12½ in. x 6 in. There are two switchboards, one for direct current and the other for alternating.

The cost of power, exclusive of fixed charges, averaged throughout the year 1903, was 8.5 mills per kw-hour. The coal consumption was 8.2 pounds per kw-hour, the cost of coal being 4.9 mills, and the cost of labor and supplies 3.6 mills. The total kw-hour output for the year was 3,586,610. The plant runs 18½ hours per day. During the latter nine months of the year three eight-hour shifts constituted the power house working day, the operating force consisting of seven men and one chief engineer. Previously the plant was run on two twelve-hour shifts, with five men and a chief. The reduced expense of the twelve-hour shift, as far as the actual money outlay goes, is illustrated by the average cost of power in December, 1902, which came to but 7.5 mills per kw-hour.

In 1904 the average for each month has been better than for the year 1903. This is in part attributed to the use of a better grade of cylinder oil in the engines. The following table shows the cost of power (exclusive of fixed charges) in this station for the first six months of this year:

POWER COST, 1904.

	Total kw-hrs. per month.	Average load in kw.	Lbs. coal per kw-hr.	Cost of coal per kw-hr. Mills.	Labor and supplies kw-hr. Mills.	Total. Mills.
January	286,320	499	8.20	4.8	3.2	8.0
February	256,100	477	8.37	4.9	3.5	8.4
March	281,290	490	8.13	4.8	3.3	8.1
April	263,690	475	7.75	4.7	3.4	8.1
May	268,850	469	8.10	5.0	3.3	8.3
June	277,805	501	8.33	4.0	3.2	7.2

The April coal consumption was lowered by the burning of about 200 tons of bituminous fuel, besides 900 tons of lignite. Repeated tests have shown in this plant that two pounds of bituminous coal are equivalent in the furnaces to three pounds of lignite.

It is interesting to get a rough idea of the total cost of power, including fixed charges. The latter are not kept at the plant, so it is necessary to approximate them. The first cost of the plant per kilowatt was about $156—the total investment being nearly $250,000. Allowing 6 per cent. interest, 6 per cent. depreciation, 1 per cent. of insurance and ½ per cent. for taxes on the investment value of the plant, we have an annual charge of about $33,800, or some $2,810 per month fixed charges. Taking the June output, the fixed charges come to 1.01 cent per kw-hour, and adding this to the 7.2 mills, the total cost of power in June, allowing for everything, reaches 1.73 cent per kw-hour. It may be objected that the cost of the plant is unduly high, but it checks very well with another installation in the far West with which the writer is familiar, and which involved heavy freight charges in its equipment and installation. These last figures are, of course, merely tentative, but the actual operating figures in the table are suggestive as showing the cost of generating power in a plant of modern design, which is kept in prime condition and constantly watched in its expenses. Non-condensing plants of this size are rather unusual, and it is, of course, an open question whether compound condensing engines would not have been a more economical installation.

The Winter-Eichberg Single-Phase Railway System.

In our issue of last week appeared an abstract of the remarks of Mr. C. O. Mailloux in discussion of Prof. McAllister's New York Electrical Society paper, which included an account of the practical working of the Winter-Eichberg electric railway system. This we are able to supplement by some views of the Kreit-Stubaithal Railway, in the Austrian Tyrol, which is the second line equipped with the system.

Herr Freidrich Eichberg, one of the inventors of the system, presented a paper at the recent International Electrical Congress, giving precise information concerning the system. The motor was said to unite the properties of the ordinary alternating-current series

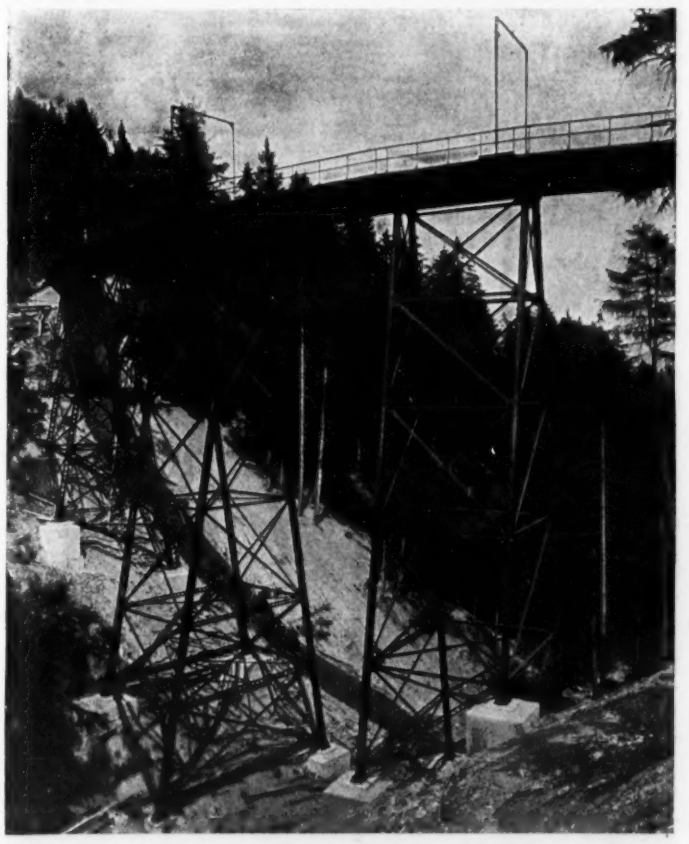


FIG. I.—HIGH STEEL VIADUCT NEAR KREIT-STUBAITHALBAHN.

motor with those of the repulsion motor. In addition to its own magnetic field, there is developed with the aid of short-circuited brushes, as in the case of the repulsion motor, a cross field which at synchronism has about the strength of the other field, but differs from it 90° in phase. This is equivalent to the statement that at synchronism a rotary field is completely established in the motor, with an approximation thereto either above or below synchronism.

The system has been operated more than a year on the Niederschoneweide-Spendersfeld line, on which during a great part of the day four 100-hp motors haul a 160-170-ton train, and 100-ton trains

are constantly being operated by two motors. The results show that the motor is adaptable to the heaviest traffic, and the direct application of 6,000 volts to the car presents no difficulties.

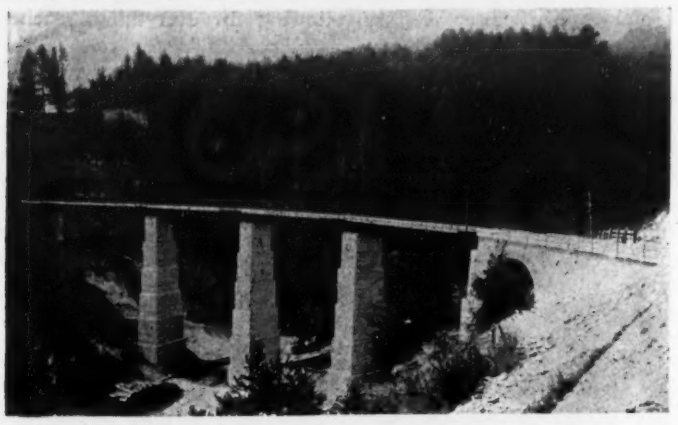


FIG. 2.—BRIDGE ON CONCRETE PIERS, STUBAITHALBAHN.

The Stubaithal line has been in operation since July 31, 1904, the voltage being 2,350 at 42 cycles. Mr. Eichberg stated that one of

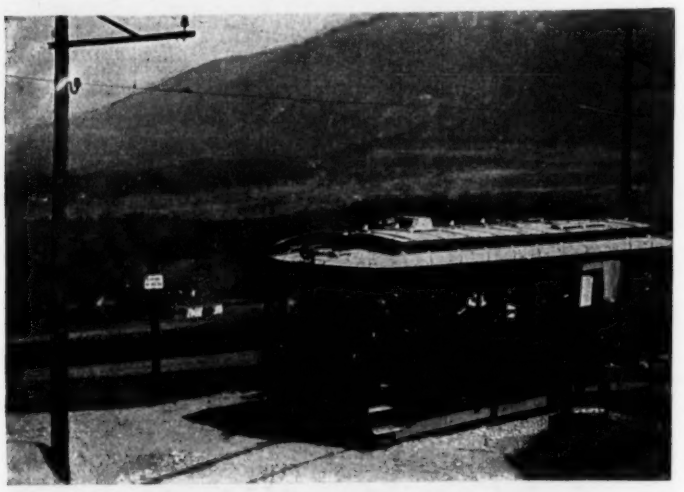


FIG. 3.—CAR AND CATENARY CONSTRUCTION.

the particular advantages of his system is its ability to operate at frequencies now in use for commercial purposes, and this united

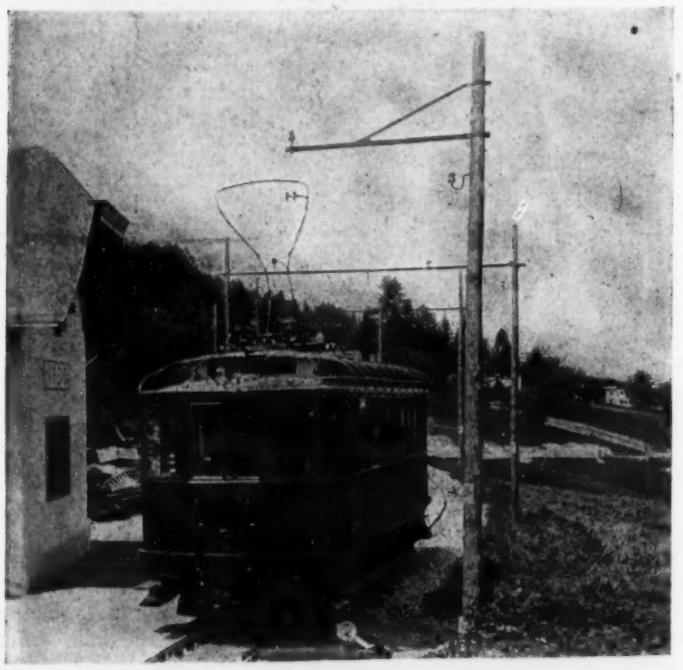


FIG. 4.—END VIEW OF CAR, SHOWING PROTECTIVE SCREEN ON ROOF.

with its property of being able also to operate with direct current, renders it particularly applicable to existing roads run in connection with a power station, also supplying lighting current.

Recent Electrochemical Developments.

ELECTRIC FURNACE CONSTRUCTION.

A combined arc and resistance furnace is patented by Prof. W. S. Franklin, of Lehigh University. It is shown in Fig. 1, its use for

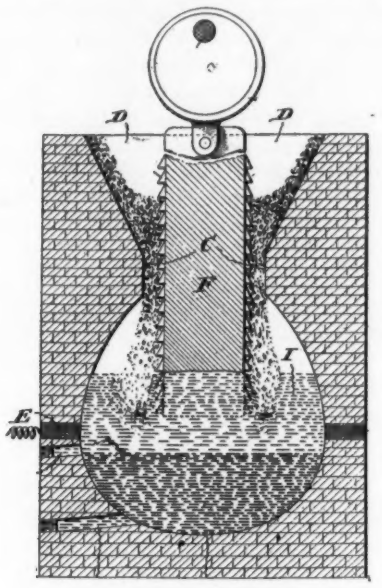


FIG. 1.—FRANKLIN ELECTRIC FURNACE.

making glass being as follows: One electrode is the carbon rod, *F*, while the other electrode is formed by the annular layer of carbon, *E*, which extends around the circumference of the furnace chamber. The latter is carbon lined and contains a hot mass, *I*, of molten glass. The raw materials from which the glass is to be formed are fed through the mouth, *D*, and passage, *C*, slowly downward by the reciprocation of the carbon rod. When the carbon rod is immersed in the molten mass, the heat effect of the electric curve is entirely due to Joulean heat, while when the carbon rod is raised above the surface of the glass, the heat from the arc is added.

Details of construction of an electric arc furnace are patented by Mr. R. Raddetz. Some features of the invention are represented in Fig. 2, which shows the regulation of the electrodes, the method of feeding in such a way that a portion of the material to be acted upon is continuously passed before the arc, while the latter is electromagnetically directed onto the material. It is, of course, possible to apply

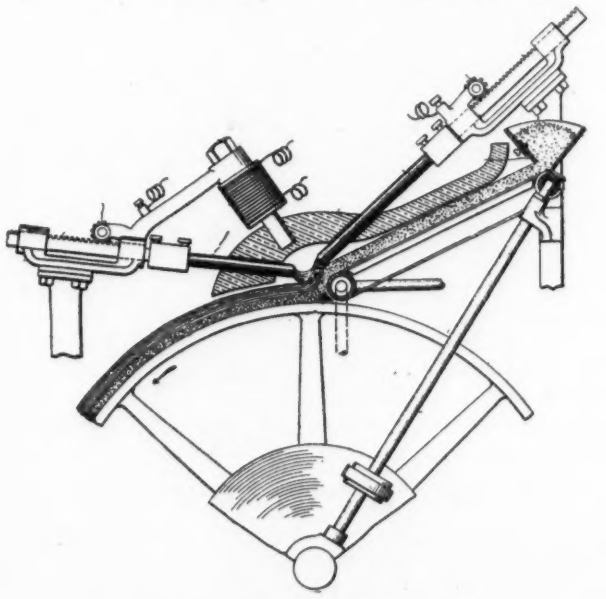


FIG. 2.—RADDETZ ELECTRIC ARC FURNACE.

automatic means for regulating the position of the electrodes by methods analogous to those used in arc lamps.

ALUMINUM.

All the commercial aluminum made at present is produced by elec-

trolyzing alumina dissolved in a fluoride bath. The discovery of this solvent is due to Charles M. Hall in this country and P. L. T. Héroult abroad, who independently developed essentially the same process. In view of the enormous increase in the uses of aluminum in recent years, it is easily understood that other inventors have been attracted by the problem of searching for other suitable solvents. A patent granted to Mr. H. S. Blackmore represents such an attempt. The inventor first describes the general principle of dissolving the highly refractory metallic oxide to be reduced in a solvent consisting of "a compound or composition of readily fusible metal-oxide or oxides which metal or metals have a greater affinity for oxygen than has the metal to be reduced," and then subjecting the mixture to electrolysis.

For the reduction of aluminum he takes oxides of lithium and calcium in proportion of about four of the former to one of the latter and fuses them; he then adds aluminum oxide which readily dissolves therein, and applies electrolysis.

MISCELLANEOUS.

A method for electroplating isolated designs on vitreous surfaces —for instance gold letters on glass surfaces—is patented by Mr. L. Blower. A metal of suitable character to form a basis for electrodeposition is reduced to a powder and mixed with a silicious or other suitable flux, which will adhere to the vitreous surface when fused. This mixture of metal and flux is mingled with a suitable substance like silicate of potash, and applied in the desired design to the glass surface. The article is then fired to fuse the decomposition in the design so that "the metal and flux are melted and the flux unites with the glass surface and the flux is separated from the fused metal in such a degree that a metallic surface is exposed suitable to form an electric conductor in an electroplating process." The desired metal is then electrolytically deposited on the design.

Another patent for his process of the fixation of atmospheric nitrogen was granted on November 15 to Prof. K. Birkeland. As has already been noticed in these columns, the process consists essentially in deviating the arc through the air to be treated by electromagnetic means, so that an extremely rapid making and breaking of arcs is obtained, giving the appearance of a light disc instead of a lighted straight arc.

Although not of a strictly electrochemical nature, two patents for thermopiles, granted to Messrs. J. A. Lyons and E. C. Broadwell, may be mentioned here. One patent refers essentially to mechanical details of construction, the object being the retardation and concentration of heat at one end of the element. To this end the inventors "use as the positive and negative elements of a thermopile a system of heat-reflecting bodies in combination with a previous material, which is preferably a loosely compressed pulverulent substance." The second patent refers to the "substitution of bars or pieces of solid metallic salts or true inorganic chemical compounds for the metals or alloys heretofore used in the construction of thermopiles." For instance, "alternate bars or plates of a mixture of iron sulphide with lead sulphide having these salts in about equal proportions are used in conjunction with bars or plates of copper phosphide to which an excess of phosphorus has been added during its formation to insure complete conversion of copper to copper phosphide and to which varying proportions of copper sulphide or tin telluride may be added."

New Telephone Patents.

IMPROVED TRUNKING CIRCUITS.

With the growth of telephone systems, and the necessary accompanying division of exchanges into several central office districts, the importance of the trunking problem becomes greater and greater. In our largest cities more than 50 per cent. of the calls must be trunked, and in one instance the trunking percentage is nearer the nineties. It is at once evident, therefore, that any saving in time in the operating of trunk connections is a source of considerable saving.

The so-called "circuit" trunking system is by far the most efficient for a large traffic between two points. But for light traffic the cost of calling circuits renders this system out of the question. Between these extremes is a zone of doubt, where the cost of calling circuits would be warranted if the trunk group were sufficiently large to give high service efficiency. In order to bring up this latter efficiency a scheme has been devised to permit of the same circuit trunks being used for both outgoing and incoming businss. Fig. 1 shows the complete circuits of such a system, in which the trunk has both outgoing jack terminals and incoming plug terminals. Trunk assignment is made by the subscriber's operator, and to avoid

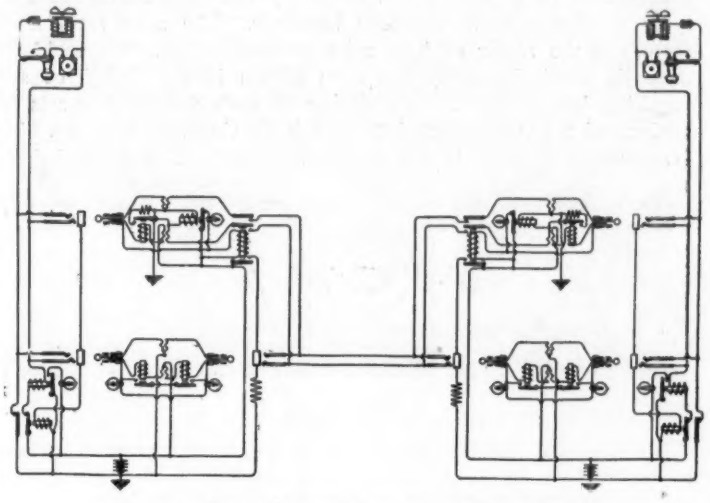


FIG. 1.—M'BERTY'S TWO-WAY TRUNKING SYSTEM.

error the use of either kind of trunk terminal puts the busy test upon the outgoing trunk jacks. F. R. McBerty, of Evanston, Ill., is the inventor of the system, his patent rights being assigned to the Western Electric Company.

Another arrangement devised by this inventor is that of an automatic trunk busy signal. With the usual circuit trunk system, in case a subscriber called for is busy, the trunk or switching operator must send some special signal back over the trunk to the subscriber's operator. To this end signal jacks are provided wired to an interrupted current and the signal is obtained by inserting the trunk plug in such a jack. With Mr. McBerty's improved circuit the mere act of testing a busy subscriber's jack causes the operation of test relays included in the trunk circuit. These automatically connect the busy signal until such time that the subscriber's operator disconnects from the trunk. The Western Electric Company has been assigned this patent also.

Another patent for a trunking circuit is that of C. A. Crapo, of Denver. This trunk provides for automatic ringing of the called subscriber. The circuit is so arranged that if the incoming end of the trunk be connected with a called subscriber, and the calling subscriber's or *A* operator has a plug in an outgoing jack of the trunk, ringing current will automatically be put upon the trunk toward the wanted line until such time as the subscriber answers or the *A* operator disconnects.

A thorough ringing system for trunks from toll switchboards is the subject of a fourth trunking patent. The circuit for this has

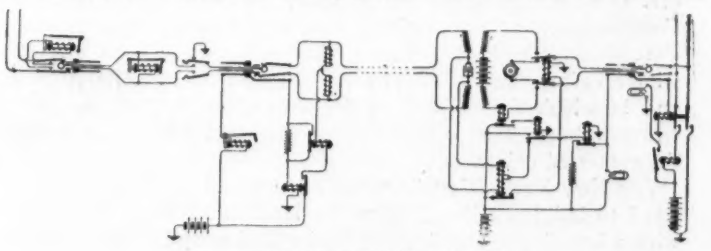


FIG. 2.—CRANE RINGING SYSTEM.

been devised by H. M. Crane, of New York City. The control of the ringing relay at the distant end of the trunk is accomplished by temporarily connecting a ground to one side of the trunk line. This disturbs the balance of a differential relay and causes it to operate. The action of the circuit will be evident from Fig. 2.

SIGNALING INTERRUPTER.

For some time past good practice has required the use of many varieties of interrupted currents for auxiliary signals at common battery exchanges. The commutators for producing the proper interruptions have usually been built upon the end of one of the ringing motor-generators and made integral therewith. D. M. Bliss, of Brookline, Mass., has now produced a self-contained and adjustable interrupter provided with coupling for attachment to any con-

venient motor. The height of the main shaft above the base is adjustable for different height motors. The Holtzer-Cabot Company has obtained the patent by assignment.

NEW PROTECTIVE DEVICES.

Within the last few years the adoption of protective apparatus has become so general that the clumsy maintenance of the early types of protectors is a serious handicap. The most troublesome feature is the repair of heat coils after operation. To avoid this difficulty much ingenuity has been shown in the design of self-repairing heat coils. A new design of such a cut-out forms the subject of a patent granted to Frank B. Cook, of Chicago. The arrangement of parts is well shown in Fig. 3. The thermal device

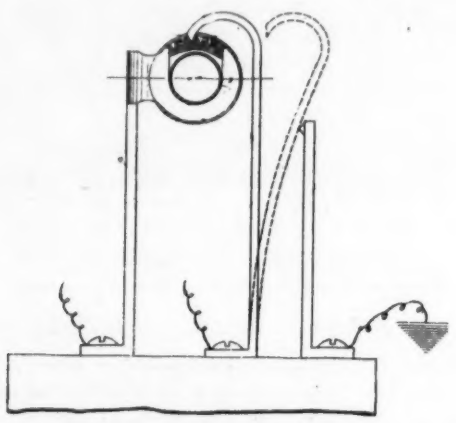


FIG. 3.—COOK PROTECTOR.

is cylindrical, the surface being serrated. This cylindrical piece can revolve between cheeks which bear upon its ends, except when it is held fast by cement or solder inserted in these joints. One side of the circuit to be protected is carried to the holder, while the other is connected to a spring piece, which may be hooked over one of the teeth of the cylinders, as shown. Upon the passage of an excessive current the thermal device softens the current and the pull of the spring piece rotates the cylinder and becomes released and flies back out of contact, opening the circuit. As the cylinder cools the cement hardens, leaving everything in readiness for re-setting.

Mr. Cook has obtained in addition a patent for a self-contained complete protector, providing thermal cut-outs, open space cut-outs and fuses. These are assembled on a porcelain base in a novel manner.

Another Electric Road for New York.

By its action last week in granting the application of the New York, Westchester & Boston Railway Company for permission to increase its capital stock from $1,000,000 to $20,000,000 and to issue first mortgage bonds to this amount, the State Board of Railroad Commissioners appears to have decided the long battle between the Port Chester and Westchester Companies which was waged last winter before the Legislature and the New York City authorities, and in which the validity of the Port Chester Company's charter was attacked. The written opinion of the board is strong on all the contested points.

The New York, Westchester & Boston Railway Company is chartered to build a railroad from the Harlem River to Port Chester, with a branch from Pelham to White Plains, and another branch to Classen's Point and Throgg's Neck, on Long Island Sound. Its plans provide for a four-track electric railroad, over a private right of way. It is announced by Dick & Robinson, bankers for the Westchester Company, that in accordance with the ordinance passed by the Board of Aldermen last July the company had already complied with the requirement that a deposit of $20,000 in approved securities be made with the Controller of the city. It has also filed its agreement to comply with the terms of the grant. A mortgage bond for $20,000,000, payable in fifty years at 5 per cent., in favor of the Knickerbocker Trust Company, as trustee, was filed last week by the company with the Registers of New York and Westchester Counties. The company also paid its State tax of one-twentieth of 1 per cent., amounting to $9,500, on the $19,000,000 additional capital stock.

The contract for the building of the road has been let and the company is negotiating for the lease of executive offices in a building down town. The purchase of the right of way of the line will, it is said, be undertaken immediately, and it is the intention to begin actual construction in the spring. The Board of Directors is to be completed within the next month, and Messrs. Dick & Robinson say that the publication of their names will reveal all the interests actively supporting the enterprise.

The Air in Electric Subways.

A subject of general interest and importance is dealt with by Prof. C. F. Chandler, of Columbia University, in his report to the New York Board of Health on the air in the Subway or underground road, about which alarming statements have circulated. Dr. Chandler says in his report: "Thus far fifty samples of Subway air have been carefully analyzed and the percentage of oxygen determined, the result being a maximum of 20.80 and a minimum of 20.30—average, 20.55. At the same time nine samples of surface air were examined, showing a minimum of 20.60 and a maximum of 20.90—average, 20.76. These samples were collected at the various stations from the City Hall to One Hundred and Sixteenth Street, at the extreme ends of the platforms and most remote from the exits or entrances. They were taken at various hours of the day, from 8.55 a.m. to 11.30 p.m.

"From these results it is evident that the air in the Subway has not in any case suffered any serious loss of oxygen, and is for all practical purposes quite equal to the air of the street, as far as healthfulness is concerned as dependent upon the percentage of oxygen. I have not yet made any analysis with a view to determine the percentage of carbon dioxide in the air in the Subway. This I shall, however, undertake next. As a matter of fact, the amount of oxygen present is a sufficient indication of the absence of any appreciable quantity of carbon dioxide. When human beings take the air into their lungs they absorb from it a certain amount of oxygen, and they add to it a somewhat smaller quantity of carbon dioxide. The high percentage of oxygen in the atmosphere of the Subway, as determined by my analysis, shows that there cannot be any serious increase in the amount of carbon dioxide, as it must in every case be less in amount than the diminution in oxygen.

"It has been suggested that the air of the Subway may be poisoned by peculiar poisonous organic substances, which some investigators think they have discovered in human breath. On this point it is simply necessary to state that the most recent and reliable investigations into the composition of air from the lungs have failed to discover any poisonous organic matter therein.

"It has further been suggested that the Subway will sooner or later become charged with dangerous bacteria. On this point I will say that the only bacteria that can find their way into the Subway are the bacteria which find their way into the atmosphere above ground and enter the atmosphere of our houses. We take them into our lungs and mouths every time we draw breath, but fortunately they are in most cases absolutely harmless; in fact, they may be considered to be the normal constituents of the atmosphere. It is true there are certain pathogenic bacteria which produce diseases, but they are no more likely to be found in the Subway than in the streets, and, for that matter, in the dwelling houses; nor can it be said for any reason that the Subway air will be a breeding place for bacteria, as bacteria cannot multiply in the absence of water, and the Subway is and probably will continue to be substantially dry.

"The results of the studies and analyses which I have thus far made satisfy me that the air of the Subway is entirely satisfactory, and that there is no cause for complaint as to its present condition or alarm for its future condition."

Geisha Girls and Trolleys.

One of the geisha girls at the St. Louis Exposition was killed by a trolley recently. The funeral party went to the grave in a trolley car. Upon returning the motorman of the funeral car was directed to back the car after reaching the geisha girls' home to conform with the custom that requires attendants at a funeral to retrace their steps before again entering their homes.

Improving Elevated Electric Traction in New York.

The planning of improvements in the electric transportation system of New York City has but barely begun. Extensive schemes for the improvement of the elevated railroad lines of the city, especially on the East Side, so that rapid transit facilities for the Bronx may be an early possibility, are under consideration by the Interborough Rapid Transit Company and by the Rapid Transit Commission. The members of the commission expect to make public a report and the entire subject then will be threshed out in public.

Chief among the suggestions now receiving the attention of August Belmont, the other Interborough officials and the commissioners is one for a complete express train service over the Second and Third Avenue elevated structures, so that the expresses may be run from City Hall to the Harlem River over the Second Avenue line without stop between Chatham Square and One Hundred and Twenty-seventh Street. This, it is believed, would give an effective service for Bronx residents and would leave the Third Avenue express track clear for express business below the Harlem River. This would need new trackage on Second Avenue.

Mr. William Barclay Parsons, the chief engineer of the Rapid Transit Commission, is committed already to the general scheme and through his advocacy the Rapid Transit Commission has largely come to the idea that the city at this time might be better served by carrying out these ideas than by starting at once to construct a new East Side Subway system. The elevated structure could be strengthened and enlarged in less than one year's time. To build the Subway would take five or six years. Also, the expenses would be about one-tenth for the structure itself, the only question in point being the damages that could be recovered by property owners along the line for new encroachments of light and air.

Several of these proposed changes have been desired for a long time, but under the old management of the Manhattan road no disposition was shown to carry them into effect. Since Mr. Belmont took over the Manhattan lines, however, and consolidated them with the Subway lines in the Interborough Rapid Transit Company, there has been a strong disposition on the part of the managers of the elevated line to carry many needed improvements into effect.

Heavy Electric Traction in England.

What can reasonably be termed a record in electric railway operation recently took place on that portion of the line of the North Eastern Railway, near Newcastle, which has been electrically equipped by the British Thomson-Houston Company, Limited.

Owing to the festivities occasioned by a visit of the Channel squadron to Newcastle, the passenger traffic on the electrified line was enormously increased, necessitating on the first day the continuous running of 86 out of the possible 89 available cars and on the following day the full complement of cars (89) between the hours of 5 p.m. and 11 p.m. Although the equipment was subjected to exceedingly heavy and unusual demands, not a single breakdown or interruption to service was experienced.

CURRENT NEWS AND NOTES.

FACTORY ELECTRIC POWER.—Mr. E. W. Lloyd, of the Chicago Edison Company, has accepted an appointment from President Davis, of the National Electric Light Association, to prepare a report on purchased electric power in factories, to be presented at the next convention of the association. Mr. Lloyd has already begun work on this report and, as it is a subject of the greatest importance to central stations—as the power load is rapidly becoming the important part of the business in many localities—it is to be hoped that managers will co-operate in the work by filling in as fully as possible the data blanks being sent out by Mr. Lloyd.

BREAK IN BUFFALO-NIAGARA FALLS TRANSMISSION LINE.—Owing to a break in the transmission line between Niagara Falls and Buffalo, all street car travel in Buffalo was suspended for two hours on the morning of November 19. It is stated that upward of 50,000 persons were compelled to walk to business. According to the press dispatches the railway company put its steam power plant into commission as soon as possible, but it was some time before power from it was available. At 8.45 o'clock service from the falls was partially resumed, and with the steam plant power fairly good service was rendered the rest of the morning.

VANADIUM GLOW LAMP.—A cable dispatch from Berlin of November 19 says: "At the twenty-fifth anniversary of the Berlin Electrical Society on November 22, Wilhelm von Siemens will present his latest invention, the vanadium glow lamp, which, it is said, will create a sensation in electrical circles. The society will confer on Herr von Siemens a medal, the first of a series to be granted every five years for the most notable electrical achievement during that period." Large deposits of vanadium exist in Colorado. Recently remarkable results have been obtained by the use of about 0.25 of vanadium in the manufacture of steel, ferro-vanadium being used for this purpose. A French metallurgical firm advertises vanadium as a content of ferro-vanadium at $12 per pound of vanadium.

OVERHEAD WIRES IN JERSEY CITY.—Mr. William Maver, Jr., has made a very complete report on the subject of removing overhead wires from poles on Newark Avenue, Jersey City, between Warren and Brunswick Streets. Mr. Maver was retained as consulting engineer to represent the city and the business men and property owners on the street. It had been claimed that it was impracticable to put the electric light wires underground owing to the marshy nature of the soil. In his report Mr. Maver showed that there were two lines of telephone conduits in the same street and no trouble had been experienced in the operation of the wires contained. The report strongly recommended that all of the overhead wires be placed underground, since owing to the large number of lines and poles and the narrowness of the street, which is one of the principal business avenues of Jersey City, they constitute a nuisance and a serious encumbrance.

KEEPING COMMUNICATIONS OPEN.—In regard to the recent interruption of telegraph service on which we commented last week, the following item of news is pertinent and suggestive, as taken from the daily papers of November 15: "A Chicago partner of the Stock Exchange firm of S. B. Chapin & Co., started a messenger for New York on the Twentieth Century Limited yesterday morning at 12.30, when the hopeless condition of the wire service was learned. Arriving at the Grand Central Station at 9.30 o'clock this morning a telephone booth was quickly secured and the orders brought from Chicago were received by the much-surprised New York member of the firm, before the opening of the market at 10 o'clock. Leaving here at 2.45 to-day the Chicago messenger will arrive at his headquarters to-morrow with a report of the securities purchased. Another messenger boy leaves Chicago to-day at 12.30 to continue the Twentieth Century messenger service until wire communication is re-established."

NAVY WIRELESS.—The Navy Department has authorized the commanding officer at the torpedo station at Newport to accept dispatches to and from ships at sea by way of the Nantucket Lightship. Orders are being prepared opening to commercial business the following naval wireless telegraph stations: Portsmouth, N. H.; Cape Ann, Mass.; Boston and New York Navy Yards; Cape Cod, Montauk, L. I.; Navesink, N. J.; Cape Henry, Va.; Dry Tortugas, Fla.; San Juan, Culebra; Yerba Buena, Cal., and Mare Island Navy Yard. Other stations will be opened in a few weeks. The immediate result of the opening of the naval wireless telegraph service on the Nantucket lightship has been the receipt of a number of letters from shipmasters and companies operating steamships by the Navy equipment bureau enclosing sums of money to defray the expenses of telegraph reports of ship movements in which the writers are interested. The bureau is returning these sums wherever possible, as it already has arranged that the Associated Press shall receive at Newport all of the reports of movements of vessels noted by the observers on the Nantucket Shoals Lightship, while any particular inquiry as to such ship movement will be answered by the naval inspector in charge of the United States torpedo station at Newport, R. I., upon application and without charge.

IRON TOWERS IN WIRELESS TELEGRAPHY.—In a letter with this title in our issue of October 29, by Mr. Max Freimark, in the fourth paragraph the clause "the reflected wave lags 90° behind" * * should read "180° behind."

STATUS OF LOCAL A. I. E. E. BRANCHES.—The Board of Directors of the University of Cincinnati officially invited delegates from the Cincinnati branch of the American Institute of Electrical Engineers to represent the Institute at the inauguration of Charles William Dabney, the new president of the University of Cincinnati. The Institute was, therefore, represented by the chairman, Mr. B. A. Behrend; the secretary, Mr. Louis E. Bogen, and by Messrs. D. Hall and C. S. Reno. The official recognition of the local branches of the Institute is a matter of considerable interest, and the chairmen and secretaries could enlarge the sphere of utility of the local in making them a factor among the scientific and engineering societies.

SAFETY DEVICE FOR ALTERNATORS.—To prevent the rush of destructive currents through the windings of alternators when placed in parallel while out of step, E. S. Baker and H. A. Scott would place fuses, rated somewhat below the normal current capacity of the machines, in the circuits leading from each alternator and would provide a switch for the purpose of shunting each fuse when the machines carry full load. According to this arrangement of connections, which forms the subject of a patent issued November 15, 1904, the fuses would open the circuits if, when the alternators were thrown in parallel, they were sufficiently out of step to cause damage, while the closing of the switches in shunt to the fuses, in event of the paralleling having been properly timed, would render the fuses inoperative and allow the machines to be loaded to the amount determined by the main line circuit-breakers.

METHOD OF ROTATING THE FIELD MAGNETS OF ALTERNATING-CURRENT GENERATORS.—Three patents, issued November 15 to C. F. Scott, have for their common object to provide a method of rotating the field magnets of alternators at slow speeds and either continuously or intermittently in order to adjust the driving engines with reference thereto. Having a source of direct current available, the fields of the alternator are energized therefrom and direct current passes through the individual phase windings on the armature in such order and such amounts as to effect the desired degree and rate of rotation. Designating the windings of a three-phase generator as *A*, *B* and *C*, the circuit would be first through *A* in series with *B* and *C* in parallel, then with *A* and *C* in series, then with *A* and *B* in parallel with *C* in series and so on alternately and progressively. A similar method of interchanging and series paralleling of circuits is applicable to two-phase generators, whether the winding be of the closed coil or open coil type. A properly disposed drum controller serves to make the connections in the order desired.

NOT ELECTRIC LIGHT.—A telegram from Chicago, of November 18, says: "Four persons were killed and a score of others were injured by a series of gas explosions that completely destroyed the plant of the Pyle Electric Headlight Company in South Chicago to-day. All the buildings near the demolished plant were badly damaged, windows were shattered for blocks and persons walking in the streets were thrown from their feet. All of the dead were buried under tons of burning timber and hot brick and iron, making it impossible to remove their bodies for hours after the accident occurred. Firemen poured water on the portion of the building in which the dead were thought to be buried until the flames were subdued. The Pyle National Electric Headlight Company is largely engaged in supplying illumination for railroad coaches. This illumination is forced into small retorts, which when attached under the floor of a car will supply it with light for months. In order to make this possible the retorts are subjected to an extremely high pressure. It was such a tank that caused the first explosion. Then retort after retort exploded, until nine were destroyed." The company was organized originally to do electric lighting.

SINGLE-PHASE RAILWAY SYSTEM.—When series motors are used interchangeably upon direct and alternating-current circuits, it is sometimes advantageous to provide resistance control for direct-current operation and potential control when alternating current is used. Such duplicate control system necessitates the installation of circuit-changing devices, in order that the proper apparatus may be employed according to the character of the propelling current available. A patent, granted November 15, 1904, to Paul M. Lincoln, relates to means for rendering the circuit-changing device automatic in operation, so that when direct current is passed through the motor circuits only the resistance control apparatus will be in series, while when alternating current is fed to the motor only the potential control devices will be responsive. To accomplish the purpose desired the inventor employs the selective devices common in telephony. The circuit-changing switch is operated by two electromagnets connected in parallel one to the other, and in series with the motor. The winding of one magnet possesses a high degree of inductance and a comparatively low degree of resistance, and hence it responds readily to direct current, though being but slightly affected by alternating current. In series with the winding of the other electromagnet is placed a condenser, which effectively interrupts any direct current, while allowing alternating current to energize the core and actuate the circuit-changing switch.

LETTER TO THE EDITORS.

Dimensions of Bus-Bars.

To the Editors of Electrical World and Engineer:

SIRS:—In 1889 Dr. A. E. Kennelly gave in the ELECTRICAL WORLD formulas and curves for determining the heating of wires by the electric current, from which it appears that with a higher current intensity the capacity per mm.² cross-section becomes smaller and smaller. The current increases proportionally with $d^{3/2}$, where d is the diameter of the wire. For cables in the earth later investigations lead to the formula, $I = (16 \text{ to } 20) \times d$, where d is the diameter of the conductor (the inner wire of concentric cables) in millimeters, and the rise of temperature is about 10° C. (50° F.). These data are so generally known that we merely use the tables with wire gauges to determine the size of a wire, and do not bother about the surface involved. Though practically the same, the principles involved often seem to be neglected in bus-bar work.

If a cross-section of copper of 3 mm. x 25 mm. (⅛ in. x 1 in.) is standardized for 100 amp., it is not at all the same as if we used for 800 amp. a bar of, say, 6 x 100 mm. or two bars of 3 x 100 mm. The surface must be considered, especially in this kind of work.

According to Kennelly, the surface must have a certain proportion to I^2R, the energy transformed into heat. On the average we have for a rise of the temperature of t° C.:

$t =$	5°	10°	20°	40°	80°
$c = \frac{s}{K} =$	225°	110°	53°	25°	10°

The loss of one watt requires a surface of 110 mm.² if the rise of the temperature is not to exceed 10° C.

If a is the loss in watts per cm. length, q the cross-section in mm.², K the conductivity, we have

$$a = \frac{i^2 \times 0.01}{q \times K}.$$

In this case the surface becomes numerically equal to the circumference $= s$, and we have

$$\frac{s}{a} = c,$$

$$s = a \times c = \frac{i^2 \times 0.01}{q \times K} \times c.$$

This is a general formula for all conductors. For copper in particular we have

$$s \times q = \frac{2\,i^2}{t},$$

if we approximately make $t \times c = 1{,}000$ and $K = 50$. As a result we have s in mm.

Now let us take the example above mentioned:

1. One copper bar of 6 x 100 mm. cross-section:

$$s = 2 \times 6 + 2 \times 100 = 212 \text{ mm.},$$
$$q = 6 \times 100 = 600 \text{ mm.}^2,$$
$$i^2 = 800^2 = 640{,}000,$$
$$t = \frac{2\,i^2}{s \times q} = \frac{1{,}280{,}000}{212 \times 600} = 10°.$$

2. Two bars of 3 x 100 mm.:

$$s = 2\ (2 \times 3 + 2 \times 100) = 412 \text{ mm.},$$
$$q = 2 \times 3 \times 100 = 600 \text{ mm.}^2,$$
$$t = \frac{1{,}280{,}000}{412 \times 600} = 5.2°.$$

If we consider that the mutual heating is extremely low, compared with direct heating, we can easily judge what we gain by using thinner bars.

There are some who still want their bus-bars insulated by tape, probably, to keep them nicely warm. But it is certainly inadvisable to cover them with a thick paint in addition. I recently saw a switchboard, the buses of which were insulated, and the different circuits were painted in red, white, blue and yellow.

PHILADELPHIA, PA. MAX FREIMARK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Short-Circuit Current of an Induction Motor.—HOWE.—If it is desired to draw the Heyland diagram for an induction motor which is already constructed and on which actual tests can be made, it is generally considered necessary to make two tests, viz.: a no-load and a short-circuit test. The current taken and the power factor are observed for each case, and the two currents, being set out to an appropriate scale from the origin at the observed angle of lag with the vertical, give two points on the semi-circle, which can then be drawn. For motors in which the magnetic saturation is low, this semi-circle will be the correct locus for the current vectors drawn from the origin for any load between no load and full load. If the magnetic saturation of the leakage paths be high the semi-circle as above determined may differ widely from the actual locus, as is shown by an experiment of the author, in which the actual short-circuit current was 170 amp., while the "theoretical" short-circuit current was 102 amp. It is the latter value, however, which must be used to construct the Heyland diagram, and not the actual short-circuit current, if the diagram is to give accurate results within the working range, i. e., from no load up to, say, 100 per cent. overload. This follows from the fact that the Heyland diagram is based on the assumption of a constant ratio between current and leakage field, which is true within the working range, and must for the construction of the diagram be assumed true throughout. This means that the curve of the short-circuit current as a function of the voltage must be a straight line. It is, therefore, not necessary nor desirable to make a short-circuit test at the normal voltage, but to determine the short-circuit currents at two lower voltages. By connecting the two corresponding points in the diagram, by a straight line, the theoretical short-circuit current for normal voltage is found. In an editorial note it is thought advisable to determine a third point so as to have a check on the two other points.—Lond. *Elec.*, November 4.

REFERENCES.

Induction Regulator.—GARCELON.—An illustrated article on the general principles and design of a polyphase induction regulator, with diagrams illustrating the method of their operation.—*Elec. Club Jour.*, November.

Induction Motors.—PRESS.—A mathematical article giving a series of formulæ for the design of induction motors.—Lond. *Elec. Rev.*, October 14.

LIGHTS AND LIGHTING.

Comparative Cost of Street Lighting by Electricity and Gas.—PEARCE.—A reprint with diagrams of the full report on tests made by him as the chief electrical engineer of Manchester, with some editorial notes on the subject. It is shown that, for a degree of illumination equivalent to 1,000 cp., lasting 4,000 hours, the cost of "intensified" gas lighting, calculated on a basis of 2.16 cents per 1,000 cp-hours, which includes 10 per cent. for depreciation, is $90. Under the same conditions and including carbons, retrimming and 10 per cent. depreciation, with electrical energy at $1.90 per unit, the cost of electric lighting works out at only $63.12. From actual measurements taken, Pearce finds that the cost per mean candle-foot per hour for the arc lamps is 0.56 cent, whereas that for intensified gas lamps is 0.79 cent. These tests can in no sense be regarded as mere laboratory experiments, since they were carried out under ordinary working conditions by practical engineers, and with an instrument the accuracy of which is beyond doubt. Pearce's figures for electric light are due, in large measure, to the low cost of electrical energy ($1.90 per unit) and to the employment of arc lamps which do not require retrimming or any other attention for many hours. At the same time, the price of gas in Manchester is also very low, and the improved system of gas lighting is claimed to be very economical as regards maintenance and labor.—Lond. *Elec.*, November 4.

POWER.

Combined Electric Plant and Refuse Destructor.—An abstract of the accounts for the first financial year's working of the Christchurch (New Zealand) electric plant, which commenced supply in 1903 on the direct-current, two-wire system. The installation is the only one in Australasia consisting of a combined refuse destructor and electricity works, the former being a four-cell Meldrum destructor, which is rendering a very satisfactory account of itself. Coal is used merely for the purpose of assisting the destructor on the peak and the total consumption for the month of August, 1904, was only 39 tons, no fewer than 26,880 units of electricity being generated. At the present time the plant is working non-condensing and it is anticipated that when condensers have been put down even this low coal consumption will be reduced. It appears that nothing is paid for steam supplied by the destructor, and although the two undertakings work in conjunction with each other, yet the accounts are kept entirely separate, the destructor having been in existence before the electricity works. Some figures are given from the work's cost. It seems that the net profit of the electric plant practically offsets the cost of working the destructor.—Lond. *Elec.*, October 28.

REFERENCES.

Gas Turbines.—NEILSON.—The first two parts of a paper read before the British Institute of Mechanical Engineers on a scientific investigation into the possibilities of gas turbines. The object of the paper is to express and compare as concisely as possible the advantages and possibilities of gas turbines worked on different cycles, and the difficulties to be overcome to make these turbines a success. The author believes that there are four cycles on which gas turbines could be worked with a possibility of good results. These are discussed with the aid of pressure-volume and entropy-temperature diagrams.—Lond. *Elec.*, October 28, November 4.

Diesel Engine.—An illustrated account of the test of a 160-hp Diesel engine. The engine "will probably show a thermal efficiency of not less than 31 per cent. on the horse-power at full loads." The operation of the Diesel engine is discussed in a separate article.—Lond. *Elec. Rev.*, November 4.

Boiler House Economies.—KERSHAW.—A communication recommending strongly that large electric stations should have a fully-trained and qualified chemist in charge of the sampling and testing of fuel. Engineers of smaller stations should employ outside assist-

ance. But fuel tests should continuously be made.—Lond. *Elec.*, November 4.

Pumps in Central Stations.—EDWARDS.—An article on pumps as a factor in the economical operation of a power plant. Oil pumps, fire pumps, feed water pumps, air pumps, circulating pumps and centrifugal pumps are considered, as well as their operation and control.—*Amer. Elec.*, November.

Resistance, Capacity and Induction in Transmission Lines.—EHNERT.—A mathematical article giving formulæ for calculating the influence of capacity, induction and resistance on overhead or underground single-phase, two-phase or three-phase lines. The author gives formulæ for calculating the electrostatic capacity and for calculating the effects of self-induction and mutual induction and shows how to deal with circuits containing capacity and inductance. Numerous numerical examples are given.—*Zeit. f. Elek.* (Vienna), September 4, 11, 18.

TRACTION.

Regenerative Control for Electric Traction.—HALL.—A paper read before the British Tramways, Light and Railways Association. It contained a general description of the Raworth system of regenerative control for tramway motors, in which the current generated by the motors on the down gradients not only assists the braking of the cars, but also returns energy to the line. The regenerative motor differs from the series motor principally in the field windings. As far as the general construction is concerned, it is a series motor. The field windings are composed of shunt and series coils wound and insulated separately from each other. The shunt coils are wound of suitable section of conductor and number of turns to carry the current necessary to secure the maximum field excitation required to give the necessary starting torque and minimum speed at which it is desired to run for regeneration. By means of the shunt field the whole of the speed regulation is effected between minimum and maximum speeds. The minimum speed is generally about 4.5 miles per hour, and the maximum 14 to 16 miles per hour, giving a speed ratio of about 3.5 to 1. The variation in field excitation is effected by means of rheostatic regulation. This is effected by means of the speed-regulating levers of the controller in about 12 steps, thus giving an average variation of speeds of about 0.8 mile per step. When it is necessary to decrease the speed below the minimum of regeneration to line, the armature circuit is automatically disconnected from the line circuit and closed through a suitable resistance, and the speed is reduced to about 1 mile per hour. The actual stopping is effected mechanically, except in cases of great emergency, when another mode of stopping is provided by means of a series field winding. In the regenerative motor the direction of the current remains constant in the field, but varies in the armature, either automatically or at the will of the driver, without altering the connections of the armature circuit.—Lond. *Elec.*, October 28. A report of regenerative motor trials is added. In the discussion which followed several speakers expressed the opinion that further experiments on the regenerative system were required before a final verdict as to its merits could be formulated.

Independent Motor Cars on Railways.—DAWSON.—A description of several types of self-contained railway cars. Accumulator cars have proved failures financially owing to the excessive cost of maintenance, battery renewals and low efficiency. The author deals at some length with steam cars and then takes up petrol cars, describing the combined petrol-electric car built for the North Eastern Railway. In an editorial discussion of this article a considerable future is expected for the independent motor car, although it is thought that their development will not interfere with the trolley system because the latter will in most cases prove more desirable when the traffic is sufficient to warrant its installation. The combination petrol and electric dynamo connected to motors on the axles is rather expensive, and the plain petrol car is usually capable of meeting the requirements. It is thought that the cost of petrol will rise if there is much demand for it, but it is fairly certain that engines using a heavier oil will be developed. The recent accident in the steam railroad tunnel under the St. Clair River is then mentioned as a case where electricity ought to be employed for steam. There is also a short editorial on the use of electric heaters, pointing out the mistake which is often made in installing too few heaters and operating them at too high a temperature.—*St. R'y Jour.*, November 5.

Permanent Way for Tramways.—CONNETT.—A paper read before the Tramways and Light Railways Association. The cost of new track varies in general from $20,000 to $30,000 per mile of single line. The author thinks that the following analysis of proportionate costs will be found to be a fair general average for new lines: Rails and fastenings, 22; special work, 10; paving material, 30; cement, sand and broken stone, 14; labor, 15; bonds, 2, and cartage and miscellaneous, 7 per cent. The author speaks first about rails and remarks that in Continental Europe one considers physical tests of rails to show sufficiently whether the product is fit; the tests are, therefore, limited to physical ones and a free hand is left to the manufacturer in other respects (chemical composition). The author then discusses mechanical joints and remarks that splice bars of special form or ordinary bars used in conjunction with some other device form the great majority of mechanical joints. He states what he considers to be the main features of a well-designed bar. He then speaks of special work, crossings and curves. He thinks that the concrete type of construction will, in all probability, remain standard in England. He finally gives some notes on paving.—Lond. *Elec.*, November 4.

Electric Freight Locomotive.—An illustrated description of electric freight locomotives for the North Eastern Railway Company. They are of the double-track type, with central cab and sloping ends, and when in running order each weighs 50 tons. The motors have two-turn armatures, the gear having a ratio of 3.28, and there is one motor mounted on each of the four axles. The Sprague-Thomson-Houston multiple-unit system has been adopted, this being similar to that used on the passenger trains. The locomotives are provided with hand brakes and with air brakes. Each locomotive, when operating on a 600-volt circuit, is capable of handling a 300-ton train on the level at a speed of 14 miles per hour and of starting with a train of 150 tons on a grade of 1 in 27 under all conditions of weather, running up this grade at a speed of 9 to 10 miles per hour.—Lond. *Elec.*, October 28.

REFERENCES.

Electro-Pneumatic System of Traction.—SAHULKA.—An illustrated description of a system of traction which is somewhat similar to that of Arnold, but is claimed to be simpler. The object of the system is to use motors which have a low starting torque, for instance, single-phase induction motors. The driving axle is acted upon by two motors. One is an electric motor of such a capacity that it can do the whole work at full speed. The other is a compressed air motor which is capable of starting the car and of driving the car alone at low speed. There is, of course, provided a third device from which the compressed air is supplied. The electric motor is the main motor, since it is alone active during the greatest part of the time. The electric motor becomes active only after a certain speed has been reached, so that it is possible to leave out nearly all the starting resistances, and to simplify the controller greatly. Several diagrams are given, showing the proposed arrangement, but it does not seem that it has been applied so far in practice.—*Zeit. f. Elek.* (Vienna), September 4.

Brakes.—FULLER.—A continuation of his serial on electric railway brakes. In this installment he discusses automatic air brakes. The introduction of multiple-unit systems of control and consequent increase in the number of electric railways operating trains has opened up a wide field for the automatic air brake. It is probable that the straight air brake will continue to be used for a time on cars that always operate singly, but modern managers will hardly consider it for train service on cars that are likely to be coupled into pairs or trains.—*Elec. Club Jour.*, November.

Energy Required when Braking with Air.—RAE.—An article recommending the general adoption of air brakes, even on single-truck city cars. The author presents a table giving the proper size of cylinders for different weights of cars; the braking effort required to stop a car and the method of calculating it, as well as the brake gear ratio. Figures are also given of the amount of air required per brake application and the cost of same.—*St. R'y Jour.*, November 5.

Four-Motor Equipment with a Two-Motor Controller.—TAYLOR.—The writer explains why two-motor controllers should not be used with four-motor equipments, as the motors must necessarily be arranged in two sets of two motors, each set having the armatures and fields connected in multiple with a jumper between the positive

field leads—a connection that is never made when using a four-motor controller, because with the latter the field of each motor can receive current only through its own armature, no matter how the motors are arranged with respect to each other. The author shows connections for the four-motor equipment with two-motor controller in series and in multiple, also the regular connections for four-motor controller in series and in multiple. The dangers arising from the use of a two-motor controller are explained.—*St. R'y Jour.*, November 12.

German Street Railway Practice.—An article on changes in German electric railway practice during the past year. A noteworthy feature is the growing tendency to furnish cars with wattmeters, as their use has been found to minimize waste of current. In power station work, units of 1,000 hp to 1,500 hp have given better results than larger ones. Storage batteries are regarded as standard equipment and have proved very economical.—*St. R'y Jour.*, November 5.

Tramway Speeds.—FEARNLEY.—A paper read before the British Association of Tramway and Light Railway officials. The author gives statistical data on maximum speeds and average speeds in England and makes plea for the permission of higher speeds.—Lond. *Elec.*, November 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Motor-Starting Switches.—A long anonymous serial in which the author points out that not sufficient attention is paid to the starting switches used in connection with electric motors. He gives 12 main requirements of a good starting switch, which are then discussed in detail. He describes several types of switches made by English companies. The article is not yet concluded.—Lond. *Elec. Eng.*, October 7, 14, 21, 28; November 4.

Voltage Regulation.—KNAPP.—An article describing, with the aid of diagrams, the method of voltage regulation in extended transmission lines by means of Tyrrell regulators (see ELECTRICAL WORLD AND ENGINEER, 1903, February 7, p. 236) and dynamic condensers.—*Elek. Zeit.*, October 27.

WIRES, WIRING AND CONDUITS.

Cable Insulation.—SCHMIDT.—An illustrated article on recent progress in insulation of cables. For making high-tension cables only two insulating materials are used at present, namely, paper and rubber, as well as combinations of the same. To obtain high flexibility with a paper-insulated cable, very thin glazed paper is used, impregnated with oil of a high fluidity. Felton and Guilleaume use a cable construction shown in Fig. 1 in which *a* is the conductor, *c*

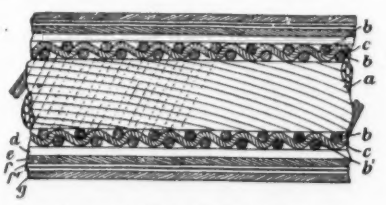


FIG. 1.—CABLE INSULATION.

the paper insulation and *b* and b^1 jute threads. Edmunds endeavors to protect the paper insulation against the effects of moisture which might come into the cable when its outside cover is hurt in some way. For this purpose he winds around the conductor alternate layers of impregnated paper, one layer being paper strips impregnated with mineral oil, the next layer being paper strips impregnated with "a solution of resin or a resin-like material in oxidized oil." Fig. 2 shows another method used by Felton and Guilleaume;

FIG. 2.—CABLE INSULATION.

a is the copper conductor, *b* insulation of vegetable fibre, which is held and pressed together by means of the texture, *c*, *d* being the lead cover. The advantages of this construction are high flexibility, low weight and ease of construction. In a method of the Köln-Lippes Cable Works rubber ribbons are used, wound around the conductor so that the ends of each layer overlap; then follows a thicker layer of impregnated vegetable fibre, held together by a lead cylinder which is then armored. The cable is treated afterward so that all cavities in the insulation are filled up. Saurer and Gentzsch use a mixture of India rubber and "Karnauba wax" as a substitute of gutta percha. The two materials are mixed in equal proportions and heated up to 200° C. with continuous kneading. The electric resistance of the mixture is somewhat higher, the dielectric constant somewhat lower than that of gutta percha. Felten and Guilleaume have used this mixture in a submarine cable of 24 km. length. The price of this cable is 35 per cent. lower than that of an ordinary gutta percha of the same type and construction. It has been in use since 1902 and has so far proved entirely satisfactory. Reissig has found that palmitate of aluminum has a high insulation resistance and is impermeable to water. The author finally mentions the insulation method of Hackethal the application of which to telephone cables has already been noticed in the Digest. —*Zeit. f. Elek.* (Vienna), September 11.

REFERENCE.

Faults.—MUNRO.—An article giving notes on faults in small lead-covered wires. The author discusses the defects of manufacture and the dangers during erection, illustrations being given of several examples of faults.—Lond. *Elec. Rev.*, October 28.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—BROCA.—A review of the present state of our knowledge with regard to the N-rays. The author refers to the numerous controversies with regard to them, and says they are only equalled by those which attended Pasteur's discoveries. He mentions that it took him six weeks of work before he saw the first N-ray phenomena. The methods are still very rudimentary and beset with numerous errors. One of the main difficulties lies in the very occurrence of N-rays in unexpected places. The author proceeds to give an account of the various ways of observing the rays, following upon the lines of Blondlot and his successors. He describes the precautions to be observed at every stage. Thus, the points between which the sensitive electric spark passes must be clean, sharp and carefully centered. The calcium sulphide should be kept in a sealed tube until required, and should be covered with a collodion film and not with gelatine. Observations cannot be made immediately after isolation. A minute is about the best interval. The effects of heat can be determined by observing the surface at an angle of 45°, at which neither N-rays nor N^1rays have any effect. —*Archives d'Elec. Medicale*, October 10; abstracted in Lond. *Elec.*, October 28.

REFERENCE.

Magnets.—HOPPE.—A paper on the constitution of magnets. From experiments made by him he concludes that any theory must be refuted which would establish a static charge on a rotating magnet. In the light of the theory of magnetic lines of force, they must be assumed to revolve with the magnet; with respect to the older theories he finds that Ampere's view is permissible, that elementary magnets may be replaced by elementary currents.—*Phys. Zeit.*, October 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—SLABY.—The third article of his series. It deals with methods for diminishing the damping effect in wireless telegraphy transmitters. The damping effect depends essentially on the ohmic resistance of the oscillating circuit; the ohmic resistance of the wire itself has little effect and the ohmic resistance of the spark-gap is of decisive importance. The author gives an example which shows that the damping effect in an oscillation circuit is governed by the resistance of the spark-gap to such a degree that all other causes of damping are comparatively of no account. Fig. 3 gives the result of experiments in which the resistance of the spark-gap was measured for various values of the capacity in the oscillation circuit, as function of the spark-gap length. The four curves refer to values of capacity equal to 120, 360, 600 and 1,100 cm. The abscissæ represent the length of the spark-gap in millimeters, the ordinates the resistance in ohms. The diagram shows that for larger capacities the resistance first increases very slowly with increasing length of the spark-gap, and only after the spark-gap has reached a certain value, the curves show a bend and the resistance increases more quickly. The resistance of the spark-gap, and, therefore, the damping effect in the oscillation cir-

cuit, can, therefore, be essentially reduced if a long spark-gap is resolved into a number of smaller spark-gaps in series. For instance, a spark-gap of 10 mm. length with a sparking potential of 30,000 volts may be replaced by three spark-gaps in series, each of 2.5 mm. length. Each of these spark-gaps has a sparking potential of 10,000 volts. If a capacity of 1,100 cm. is used, the spark-gap of 10 mm. has a resistance of about 15 ohms, while the three spark-gaps, each of 2.5 mm., in series, represent only a resistance of three

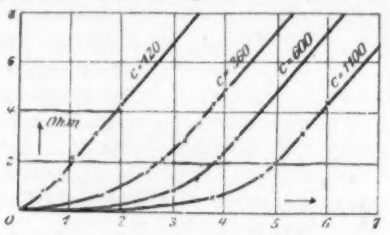


FIG. 3.—WIRELESS TELEGRAPHY.

times 0.2, that is, 0.6 ohm. This shows how much the resistance of the spark-gap, and therewith the damping effect, may be reduced by this method. The spark-gaps should be air-gaps, and no oil should be used, since sparks in oil have a resistance 10 times of that of sparks in air. In the laboratory an extraordinary increase of effects is observed if an oil-gap is substituted for an air-gap, but this is true only for the electric or voltage effects, but not for the magnetic effects. The latter are the important ones for transmission. The author finally makes some remarks on the influence of the form and material of the globes between which the sparks pass over. The most suitable metals for short spark lengths are tin, silver, cadmium and lead.—*Elek. Zeit.*, October 27.

MISCELLANEOUS.

Electric Heating of Steel.—GLEDHILL.—In an Iron and Steel Institute paper on the development and use of high-speed tool steels two methods of heating tools by electrical means are described, by which very regular and rapid heating is obtained; where electric current is available the system of electric heating is said to be quick, reliable and economical. For one method the apparatus consists of a cast-iron tank, of suitable dimensions, containing a strong solution of potassium carbonate, together with a dynamo, the positive cable from which is connected to the metal clip holding the tool to be heated, while the negative cable is connected direct on the tank. The tool to be hardened is held in a suitable clip to insure good contact. The current is first switched on and then the tool is gently lowered into the solution to such a depth as required to harden it. The act of dipping the tool into the alkaline solution completes the electric circuit, and at once sets up intense heat on the immersed part. When the tool is sufficiently heated the current is switched off, and the solution rapidly chills and hardens the point of the tool, so that no air blast is necessary. Another method of heating the point of tools is by means of the electric arc, the heating effect of which is also very rapid in its action. The tool under treatment and the positive electrode are placed on a bed of non-conducting and non-combustible material and the arc started gradually at a low voltage and steadily increased as required, by controlling the shunt rheostat, care being taken not to obtain too great a heat and so fuse the end of the tool. The source of power in this case is a motor-generator consisting of a continuous-current, shunt-wound motor at 220 volts, coupled to a continuous-current, shunt-wound dynamo at from 50 to 150 volts. Arcs from 10 to 1,000 amp. are then easily produced and simply and safely controlled by means of the shunt rheostat.—*Iron Age*, November 10.

Patent Law.—HANSSEN.—A note on his presidential address, delivered before the Civil and Mechanical Engineers' Society in London, on the effect of patent law on modern civilization. The address throughout was a strong plea for the better protection and remuneration of the inventor. James Watt would have received practically no return at all unless his patent had been extended over 31 years, while landowners along routes of many railways have had the value of their property increased enormously. The whole tendency of the law seems to be to consider the patentee as an undesirable person, who is plundering the community by means of his patent. The author said that it would be to the advantage of all classes if such views could be changed, and the law so amended as to encourage invention by making patents sufficiently safe as investments and of sufficiently long duration to repay the heavy expenditure generally incurred in developing a new invention and in bringing it before the public. A patent, he thought, should be given approximately the same validity as an act of Parliament, but at a very much lower cost, and it should be possible to prolong its life under proper conditions dependent on the capital spent in developing it. Further, if patents, instead of being issued at a uniform rate of taxation. were taken according to the income derived from the monopoly, a very considerable revenue might be obtained from successful patents, while the charges for undeveloped inventions might be correspondingly lowered.—Lond. *Elec.*, November 4.

Color Photography.—ROTHE.—An account of experiments in which the author has succeeded in obtaining Lippmann photographs without the aid of a mercury mirror. He noticed that the gelatine side of an underexposed Lippmann negative presented by reflection colors varying with the thickness of the gelatine. He found that these colors were due to reflection, not from the mercury mirror adjoining the gelatine, but from a thin film of unexpelled air. He therefore took photographs without the mercury mirror, simply exposing the plate with its film away from the lens. The exposure was long, and amounted to half an hour in sunlight and two hours in a well-lighted room. A spectrum of an arc lamp took 15 minutes. The exposure may be reduced to a few minutes by treating the plates before use with an alcoholic solution of silver nitrate. Pyrogallic acid is the best developer, and the negatives may be intensified with mercuric chloride and amidol. The colors are less vivid than those obtained with the mercury mirror. All the colors except the extreme red are faithfully reproduced. The method is within the reach of any amateur.—*Comptes Rendus*, October 10; abstracted in Lond. *Elec.*, November 4.

REFERENCE.

Induction Coils for Medical Purposes.—JONES.—A paper, the object of which is to bring to the notice of the medical profession the results of an examination of the characteristic curves of certain medical induction coils. These curves were taken with Duddell's oscillograph.—Lond. *Elec.*, October 4.

Alternating-Current Traction from Gas Power.

A somewhat unique departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren & Jamestown Street Railway Company is equipping a single-phase electric railway system to operate between Warren, Pa., and Jamestown, N. Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa.

The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two Westinghouse gas engines, each of 500-hp capacity. They will be of the horizontal, single-crank, double-acting type, direct-connected to two 260-kw Westinghouse generators furnishing current at a voltage sufficient for direct use upon the high-tension transmission line. The power equipment also comprises a 55-hp gas engine for operating air compressor and exciter units. Natural gas will be furnished by the local distributing company. In this district the gas has a calorific value of about 1,000 B.T.U. per cu. ft.

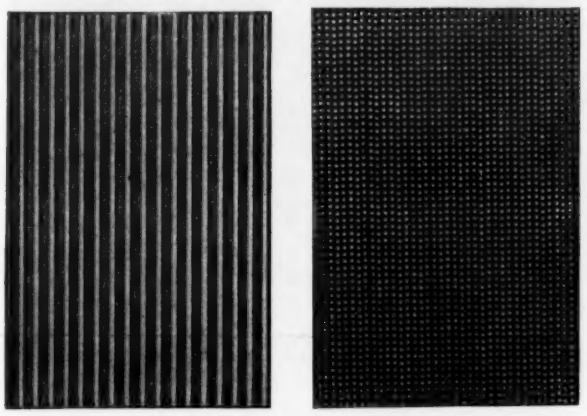
Transformer sub-stations, five in number, will be located along the right of way. These will receive the high-tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of single-phase motors, each approximately 50-hp capacity.

An interesting feature of the system is the arrangement for operating the alternating-current motors upon the direct-current trolley lines within the city limits of the termini. The Warren & Jamestown Street Railway is not a newly organized system, as it has operated part of the present lines for a period of eleven years. Three years ago the company began experimenting with the use of gas power, with sufficient success to influence it in the now exclusive adoption of gas engines for its entire power generation. The operation of the new system will be watched with much interest by the engineering public.

Storage Batteries for Stationary and Vehicle Work.

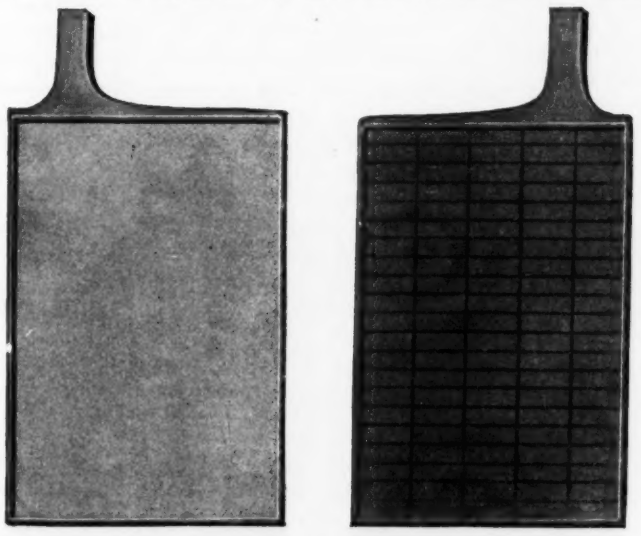
The New England Motor Company, of Lowell, Mass., is manufacturing a complete line of storage batteries for stationary or vehicle work, the details of which have been very carefully worked out. It also manufactures a line of small portable batteries for ignition purposes, or for running phonographs, etc.

These batteries are of the pasted type, the active material being applied to grids. The negative grids are formed of practically pure lead and the positives of an inoxidizable alloy. Wooden separators, Fig. 1, and rubber separators, Fig. 2, are used. The wood is treated



FIGS. 1 AND 2.—WOODEN AND RUBBER SEPARATORS.

by a special process to prevent the formation of acetic acid or gum dextrine, during the subsequent operation of the battery. The negative paste consists of litharge and dilute sulphuric acid, applied in the usual manner. Fig. 3 shows the negative plate after formation. The positive paste, however, is of a secret composition, and it is claimed for it that while possessing all the porosity which it is possible to obtain by any method of pasting, still the peroxide which is obtained by this method is of much greater hardness, and shows much less tendency toward disintegration, or powdering, in the cell than is obtainable by any other process. This result is



FIGS. 3 AND 4.—NEGATIVE AND POSITIVE PLATES.

stated to have only been attained after years of patient experimenting by the New England Motor Company. A much longer life

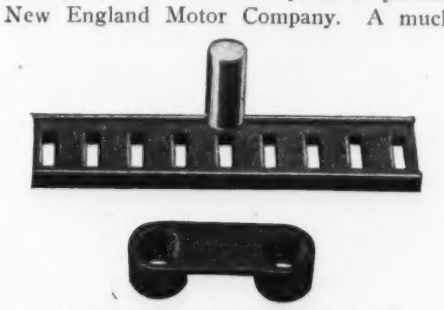


FIG. 5.—STRAP AND CONNECTING LINK.

and a greater output per pound of complete cell is claimed on account of this peculiarity of the positive plates.

The company furnishes new positive plates, shown in Fig. 4, for use with any of the ordinary standard makes of batteries. As it has been the universal experience that the deterioration of the positives is the main source of expense and trouble in the operation of a storage battery, users may substitute for the old types of plates which have become spongy during use, a set of these new plates, which are firm and hard, and have considerable density, and will add greatly to the capacity of the battery.

Fig. 5 shows the strap with its post and also the connecting link, as used by the manufacturers. Fig. 6 shows two complete cells of 150 amp.-hour size, assembled and burned together. Care is taken that no dissimilar metal is used in forming the joint; that is, the

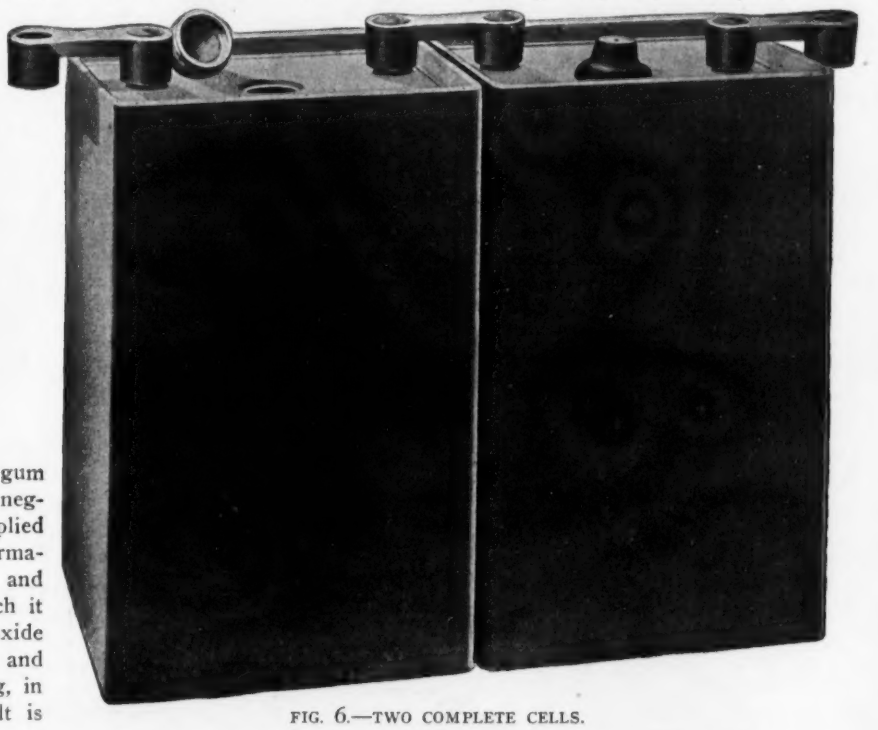


FIG. 6.—TWO COMPLETE CELLS.

positive straps are made of the same alloy as the positive plates, and in burning the positive plates to the straps care is taken to use metal of the same alloy. This prevents electrolysis, which has been a fruitful source of trouble in the past, as it has been the custom among a great number of manufacturers to burn plates which consisted of an alloy of antimony and lead to a strap which consists of nearly pure lead, and to use pure lead for making the junction. As these joints are exposed to the action of the electrolyte, being underneath the cover of the cell, the result is a gradual eating away of the joint by means of electrolysis and consequent trouble for the user, which is prevented by the use of homogeneous materials throughout.

Christmas Tree Lamp Socket.

At this season of the year preparations are making for the holiday season. One of the effective bits of decorative lighting that will be done is the illumination of Christmas trees. This of late years has been accomplished not only in residences, but in department stores, both in the toy department and window displays.

Some people have a hesitancy about lighting a Christmas tree by using wax candles, as instances are not rare where serious fires have been caused. Of recent years the tendency has been in the direction of electric lighting

LAMP SOCKET.

A device is being put on the market which is admirably adapted to Christmas display and tree illumination. It consists of a brass socket for miniature incandescent lamps made of a size to fit any standard miniature base. The brass shell is pierced at the bottom and there is introduced through a hole thus made a tack which is securely fastened in place and which forms a part of the lighting circuit. This tack holds the socket firmly in place on the branch of the Christmas tree, and short-circuit is made impossible by the use of a fibre strip which is placed outside of the socket and surrounding the tack. Soldered to one side of the socket and again

to the tack are the connecting wires. Each lamp thus forms an independent unit and the widest latitude in the arrangement of the lamps is permitted. These wires of course may be of any length in order to connect to the feed wires, and as they are covered with green silk they lend themselves to a concealed wiring effect. The wires may be run along the branches to the main stem of the tree, or may be disposed of in any satisfactory way. The device is made by William Roche, 52 Park Place, New York, the well-known manufacturer of dry batteries and hand flash lamps.

Single-Phase and Self-Starting Motors.

In the accompanying illustrations Fig. 1 shows the parts of a Stanley self-starting, single-phase condenser motor; Fig. 2 the details of a combined pulley and starting clutch for this motor, and Fig. 3 the condenser. In this type of motor the condenser is connected between a point in the field winding and one of the two main terminals of the motor. Owing to the capacity effect of the condenser, the current in part of the field winding is displaced in phase with relation to that from the main line, the result of this being to produce a good starting torque, as in a polyphase motor. With this arrangement the required starting torque is supplied without a commutator or similar objectionable feature. Furthermore, the condenser is left connected in circuit at all times, and since it neutralizes the lagging factor in the motor the result is a power factor at the main terminals of the motor which is very high, and in the larger size is practically equal to 100 per cent. through wide variations of load. In fact, the capacity of the condenser in the larger motors is more than enough to neutralize the lag at light loads, so that the motor currents are actually leading, thereby assisting the voltage regulation on the main circuit. In all but the smallest motors a starting resistance may be used to keep the starting current below the full load value. This starting resistance, which is enclosed in the armature, is short-circuited after the motor has reached full speed by means of a simple kind of switch operated automatically by centrifugal force.

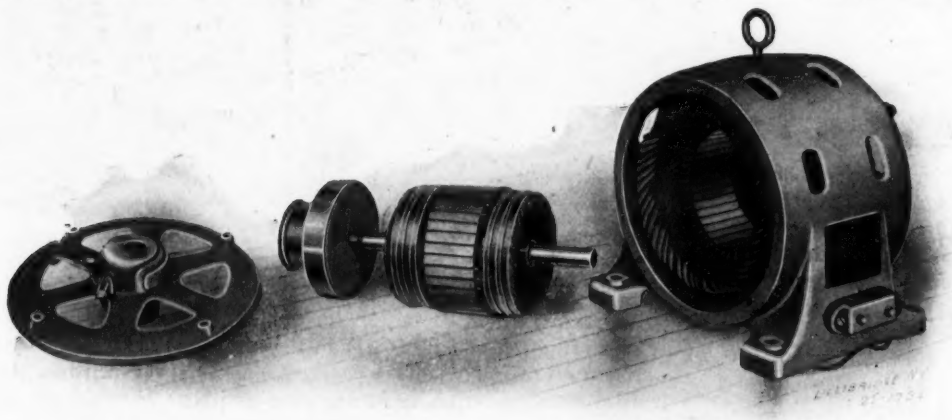


FIG. 1.—PARTS OF CONDENSER MOTOR.

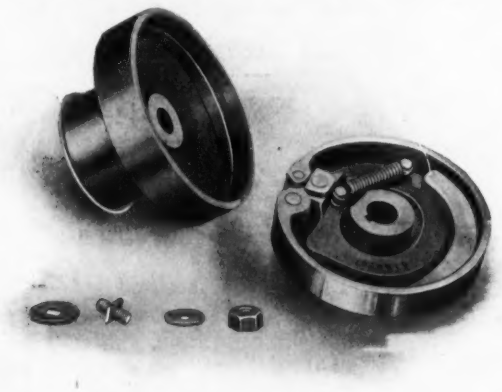


FIG. 2.—DETAILS OF COMBINED PULLEY AND STARTING CLUTCH.

Each motor is supplied with a combined pulley and friction clutch, shown in detail in Fig. 2. When the armature stands at rest this clutch is released, and when the armature has nearly reached full speed the centrifugal force, acting on weights in the clutch, automatically causes a steel spring to expand and press on the inside of the pulley rim, with the result that the belt is gradually brought up to full speed. By this means the current taken by the motor to actually start the load is only in proportion to that load.

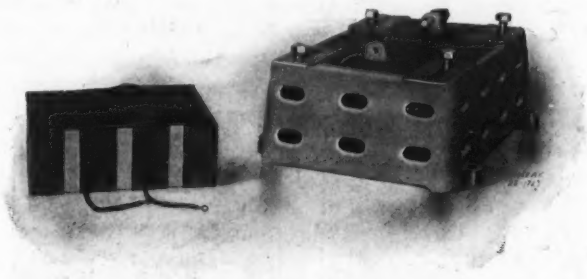


FIG. 3.—VIEW OF CONDENSER.

The frames of the motors are so shaped as to almost entirely enclose the motor, but they are cast with openings of such sizes and in such positions that air is drawn in at certain places, and by means of the rotary motion of the armature is thoroughly circulated around the various parts where heat is developed and then expelled through other openings. The result is that the temperatures are exceedingly low and evenly distributed. The maximum rise in temperature will not exceed 40° C. under full load. The condensers are sealed in air-tight metal cases to protect them from moisture and from injury of every sort. The motor terminals are so designed that when the motor is properly installed they are entirely protected, and it is impossible for anyone to touch any metal connected with the circuit or receive a shock in any way. In case it is desired to operate the motors by fastening them to the wall or ceiling, this can be easily accomplished by turning the end frames containing the oil reservoirs 90° or 180° from their normal position.

The same type of motor is made in small sizes for hand starting, condensers not being used. A pull on the belt by giving motion to the armature will set up current displaced in phase with relation to the field, and the motor will then increase in speed up to synchronism.

The Cost of Lighting Cigars by Electricity.

An ingenious electric cigar lighter has recently been placed in service in a Boston restaurant, and the simplicity of its operation, coupled with the low cost of power use, commend it to the interest of engineers and others who appreciate the lesser applications of electricity as well as large undertakings.

The apparatus consists of a metal box, perforated and mounted upon a standard and supplied with 110-volt, direct current from the Edison lighting mains. Inside the box are two carbon pencils, which are brought in contact by the depression of a thumbpiece or button on the outside and then separated by a spring mechanism which holds the carbons just far enough apart for an arc to be formed. By inserting a cigar in an orifice in the front, the unlighted end of the weed becomes ignited by contact with the arc, the whole operation taking scarcely five seconds.

It is interesting to figure the cost of lighting a cigar on the basis of 10 cents per kw-hour. The current consumption is approximately 2.5 amp., so that the energy consumption in a single five-second contact comes to 1,375 watt-seconds, or .382 watt-hours. This is .000382 kw-hours, and the cost of lighting a cigar figures 3.8 mills—a small

sum in consideration of the convenience, cleanliness and freedom from the danger of fire, ill-smelling gases, etc. It is in little ways like the foregoing that electricity is constantly proving more and more useful in everyday life, as well as in larger fields of power work. The apparatus above described was made by the Simplex Electric Company, of Cambridgeport, Mass. The cover of the box is perforated to allow the heat of the arc and the cigar smoke to readily escape. A particular feature of the apparatus is its non-consumption of current except when the thumb lever is depressed.

Mechanical Speed Control.

The accompanying illustrations show the principles of an apparatus known as the "Speed Jack," manufactured by the Reed-Morrill Electric Company, 1035 Ridge Avenue, Philadelphia, for obtaining a wide range of speed when power is taken from a shaft running at constant speed.

Fig. 1 shows the appearance of the arrangement and Fig. 2 is a sectional view. Referring to Fig. 1, in case an increase of speed

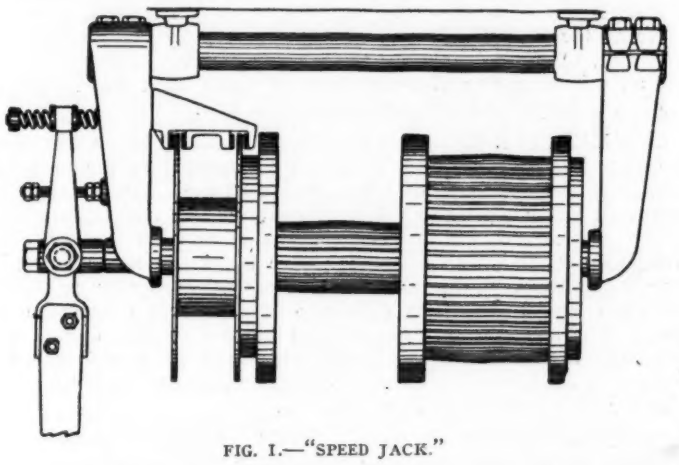


FIG. 1.—"SPEED JACK."

is demanded, the driving belt works on the pulley to the right and the driven belt on the pulley to the left. The pulleys, with their adjusting arrangement, are hung from two arms fixed to a shaft held in loose bearings; the object of this method of flexible hanging will be seen later.

Referring again to Figs. 1 and 2 and to the details of Fig. 3, it

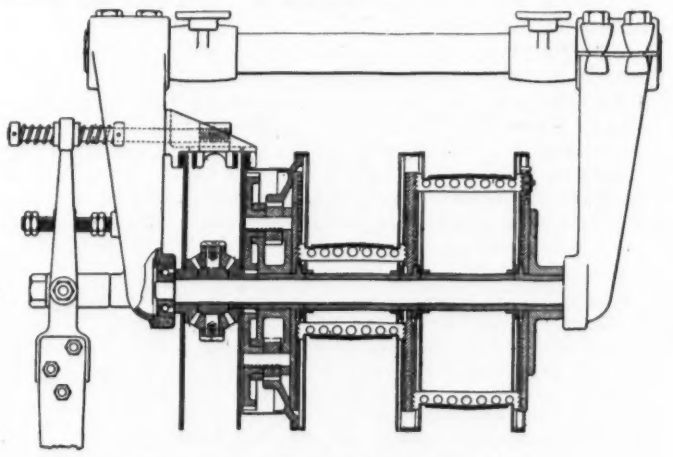


FIG. 2.—SECTIONAL VIEW OF SPEED JACK.

will be seen that the face of the pulley is made up of a large number of slats or rim sections (*D*, Fig. 3), which fit at both ends into a scroll plate (*H*, Fig. 3) and are guided by slots in two discs, as shown in *G*, Fig. 3. By means of the pair of scroll plates the slats of a pulley may be moved farther from or nearer to the axis of the pulley shaft, thereby increasing or decreasing the diameter of the pulley. This is accomplished by means of a gearing arrangement, shown at the left of Fig. 2. If the shifter arm, shown to the left of this figure, is moved in one direction a clutch claw is pressed against a clutch disc, gripping it and preventing rotation. This through a train and bevel gears gives relative motion in one direction to the guide plates with reference to the scrolls, the latter being pinned to their shaft and the guide plates being movable and connected through the gears to the shaft. Moving the shifter in an opposite direction clutches the second clutch disc, thereby causing relative motion of the guide plates and scrolls in the opposite direction. The relative motion of the scrolls and guide plates causes one set of slats or arm sections to be moved upward from the shaft and the other set to be moved downward from the shaft. The simultaneous expansion of one pulley and contraction of the other main-

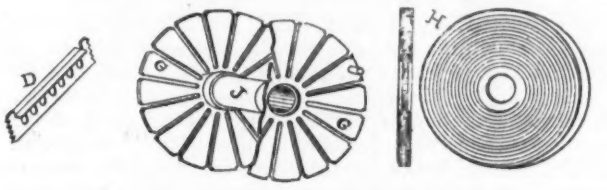


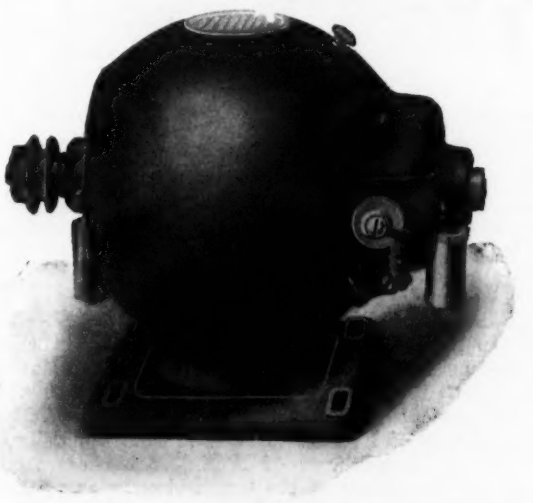
FIG. 3.—DETAILS OF SPEED JACK.

tains an equal tension on the belts; the position in space of the pulley shaft, however, necessarily changes and to provide for this the pulley is hung flexibly.

By this means, of which Mr. C. J. Reed is the inventor, a change of speed through a wide range—as great as 10 to 1—may be obtained almost instantly, and merely by moving the shifting arm. The journals have ball bearings and there are no end thrusts or stresses between the component parts of the apparatus to provide for.

Small Direct-Current Motors.

The accompanying illustration shows a new type of spherical motor manufactured by the Emerson Electric Manufacturing Company, St. Louis, Mo. These motors are wound shunt and series in two frames, the smaller being rated at 1/20 to 1/12 hp at speeds from 1,800 to 3,000 r.p.m.; the larger frame, although taking up only a slightly greater amount of space, will develop from 1/10 to ⅙ hp at from 1,500 to 2,800 r.p.m. One of the unusual features of these motors is a solid frame which entirely encloses the field, commutator and brushes, keeping out all dirt and dust, and permitting the motor to be placed in out-of-the-way corners and operated without frequent attention. A removable shutter secured by a thumb-nut per-



SPHERICAL MOTOR.

mits inspection of the brushes and commutator, and makes them readily accessible for adjustment or cleaning. These motors may be reversed without removing the covers. They have 3/8-in. tool steel shafts, ground accurately to size, and self-aligning bronze bearings, and are capable of handling a class of work impossible to many types of the same rating.

Insulator Awards.

The Locke Insulator Manufacturing Company, Victor, N. Y., has received as an award at the St. Louis Exposition a gold medal for its exhibit of high-potential glass and porcelain insulators and special insulating material.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Stock market speculation was active, though mainly professional, despite the apparent increase in public interest. In the early part of the week gold shipments and unsettled conditions in foreign markets caused a reaction, from which, however, the market rallied sharply on a variety of favorable developments concerning industrial and railroad properties. The United States Steel issues did not, however, respond at once to these influences. Later on Steel stocks advanced easily and made new high-record prices. Traction stocks were active in trading. Brooklyn Rapid Transit reached 70½, but receded and closed at 68, which is a net gain of ¼ point. Metropolitan Street Railway made a net gain of 1 point, closing at 124⅜. The electrics are all higher. Allis-Chalmers common and preferred both reached the highest quotations of the year, closing at 20¾ and 68, respectively, these prices being net gains of 6¾ for the common and 13 points for the preferred. General Electric and Westinghouse common also reached the year's highest level for these stocks, the former closing with a net gain of 5 points, and the latter with 1, the last quotations being 185 and 177, respectively. Westinghouse preferred closed at 194, thus scoring an advance of 2 points. Western Union is off ¾-point, the closing quotation being 92. American Telephone & Telegraph advanced to 146 and closed at 145½, a gain of 1½ points. Curb stocks were active and generally higher, copper stocks being the most active on the list. Interborough Rapid Transit closed at 154. Following are the closing quotations of November 22:

NEW YORK

	Nov. 15	Nov. 22		Nov. 15	Nov. 22
Allis-Chalmers Co.	15¾	18⅜	Electric Vehicle	15¼	16
Allis-Chalmers Co. pfd.	61	69	Electric Vehicle pfd.	21	24
American Tel. & Cable.	91	89	General Electric.	180	189¾
American Tel. & Tel.	144	144	Hudson River Tel.	...	...
American Dist. Tel.	28	30	Interborough Rap. Tran.	155¾	158
Brooklyn Rapid Transit.	69¼	68	Metropolitan St. Ry.	123⅜	123¾
Commercial Cable.	210	210	N. Y. & N. J Tel.	158	160
Electric Boat	41	42	Marconi Tel.	..	..
Electric Boat pfd.	67	68	Western Union Tel.	92	91⅜
Electric Lead Reduction.	⅛	⅛	Westinghouse com	174	180
			Westinghouse pfd	190	193

BOSTON

	Nov. 15	Nov. 22		Nov. 15	Nov. 22
American Tel. & Tel.	144	145	Western Tel. & Tel. pfd.	*101	*100
Cumberland Telephone.	..	117	Mexican Telephone.	2⅛	2
Edison Elec. Illum.	243	245	New England Telephone.	134	*134
General Electric.	..	189¾	Mass. Elec. Ry.	15¾	16
Western Tel. & Tel.	22	21	Mass. Elec Ry. pfd.	58	61

PHILADELPHIA.

	Nov. 15	Nov. 22		Nov. 15	Nov. 22
American Railways.	49¼	49⅛	Phila. Traction.	97⅛	97¾
Elec. Storage Battery.	75⅛	81⅛	Phila. Electric.	8⅞	8⅛
Elec. Storage Battery pfd.	75⅛	81⅛	Phila. Rapid Trans.	18⅞	17⅛
Elec. Co. of America.	10¾	10¼			

CHICAGO

	Nov. 15	Nov. 22		Nov. 15	Nov. 22
Central Union Tel.	†	..	National Carbon pfd.	†	109
Chicago Edison.	†	170	Metropolitan Elev. com.	†	24
Chicago City Ry.	†	189	Union Traction.	†	13
Chicago Tel. Co.	†	145	Union Traction pfd.	†	43¾
National Carbon.	†	42⅛			

* Asked. † No quotations received.

BALTIMORE LIGHTING CONSOLIDATION.—A special dispatch from Baltimore, of November 18, says: "It is believed there is a big deal on for the consolidation of the Consolidated Gas Company and the United Electric Light & Power Company to control all the lighting interests in Baltimore under Thomas F. Ryan and Anthony N. Brady, of New York, and the Continental Trust Company of Baltimore. A syndicate of Baltimore bankers who have been interested in the affairs of the Consolidated Gas Company is making the effort to secure an option on the shares held by the stockholders. The Maryland Telephone & Telegraph Company is also mentioned in connection with the deal. President S. Davies Warfield of the Continental Trust Company, is one of the prime movers in the contemplated merger, and in the negotiations with President David E. Evans and George R. Webb, of the Maryland Company. United Electric Light & Power preferred stock sold at 40 to-day, an advance of 1 point over Thursday. About 740 shares of preferred stock sold on the Baltimore Stock Exchange to-day, all for New York parties. There are only 14,000 shares of Electric Light & Power preferred, not controlled by the Brady-Ryan-Warfield interests, while Mr. Brady and his friends control the common stock."

SEATTLE-TACOMA POWER.—Early completion is promised of the reorganization of the Snoqualmie electrical companies. Mr. Charles H. Baker, the president, will retire from the executive management of the companies, and may be succeeded by Mr. O. D. Calvin, who will continue to act as general manager. The capital stock will be increased to $3,500,000 from $3,000,000, and bonds for a large amount may be issued. It is understood that these bonds were negotiated last month in New York. The new company will be known as the Seattle-Tacoma Power Company. The present title in full is the Snoqualmie Falls & White River Power Company. It owns the power plant at the falls and distributing systems at Seattle and Tacoma. The White River Company may remain for a while as an independent corporation. It is now building a power plant at Lake Tappo, in Pierce County.

BOSTON EDISON.—The stockholders of the Boston Edison Co. at a special meeting held November 18 voted to increase the capital stock of the corporation from $10,449,100 to $11,494,100. From this new stock issue the company will receive $2,100,000, which will be used to wipe out the floating debt incurred through the purchase of suburban electric properties and for extensions and improvements to the Boston plant. The directors of the company subsequently voted to offer stockholders of record 10,450 shares of new stock at $200 a share at the rate of one new share for every 10 share now held. The right to subscribe expires at the close of business December 15, and all subscriptions and assignments of rights must be received at the Old Colony Trust Company before that date.

COMMERCIAL CABLE PLANS.—It is stated by an official of the American Telephone & Telegraph Company that the proposed change in the certificate of incorporation of the Commercial Cable to permit that company to sell its property to any telegraph or telephone company is not significant in its relation to the American Telephone & Telegraph Company. The latter has no intention of purchasing the Commercial Cable Company property or combining with the Postal Telegraph Company or any other telegraph company. The action of the Commercial Cable Company directors in proposing a change in its certificate of incorporation was unknown to American Telephone & Telegraph officials until after the issue of the circular already noted in these columns.

SALE OF CHICAGO CITY LINES.—An announcement from Chicago of November 20 says: "Thirty-six million dollars is to be paid for the Chicago City Railroad Company by a syndicate headed by Marshall Field, P. A. Valentine and John J. Mitchell, of Chicago, and J. Pierpont Morgan, Thomas Ryan and their associates of New York City. Mr. Morgan's Wall Street firm and one other trust company, not yet named, will underwrite the deal. Announcement will soon be made to the public, which is to be informed that the moneyed men of the East and West, having joined hands, will buy up City Railway stock at $200 a share, which is considerably more than the present market price."

PORT CHESTER ROAD CAPITAL.—An application of the New York & Port Chester Railroad for consent to issue a mortgage for $15,000 and an application for the approval of a proposed increase of the capital stock from $250,000 to $15,000,000 were before the State Railroad Commission, at its meeting last week. W. C. Trull, one of the attorneys for the railroad, asked for an adjournment, on the ground that Frank Sullivan Smith, principal counsel for the railroad, was unable to appear. The request was granted, and the hearing was adjourned to December 6.

NEW HAMPSHIRE TRACTION.—The New Hampshire Traction Company, which operates a number of lines in Southeastern New Hampshire and extending over the Massachusetts border, is to be reorganized. A plan has been submitted which provides for a foreclosure and the formation of a new corporation with $4,000,000 4 per cent. non-cumulative preferred stock, and $4,000,000 of common stock. Bondholders are to receive preferred and common stock, and holders of certificates of indebtedness will take common stock.

DIVIDENDS.—The Philadelphia Electric Company has declared the regular semi-annual dividend of 2½ per cent. on the paid-in capital, payable December 15. The directors of the National Carbon Company have declared a dividend of 1½ per cent. on the common stock, payable January 14. This will be the first dividend the common stock has ever received.

WESTERN TELEPHONE STOCK.—It is stated that the preferred stock of the Western Telephone Company will be placed upon a 6 per cent. basis, and it is claimed that in Texas alone the company earned that much during the first nine months of the year.

CHICAGO EDISON.—The directors of the Chicago Edison Company have voted to issue 20 per cent. more capital stock to stockholders, at par, payable in four installments, viz: February 1, 1905; May 1, August 1 and November 1.

Commercial Intelligence.

THE WEEK IN TRADE.—The interruption of telegraphic communication by last week's storm retarded business somewhat, but the loss was quickly recovered, and retail trade responded to the lower temperature, while a large jobbing distribution of holiday goods occurred. The mills at Fall River were reopened, but the operatives did not return in sufficient numbers to keep the machinery active. Trading generally shows gains over corresponding periods of last year, and the aggregate of the year's business in most lines will make a better showing than was recently thought possible. Money is very easy; crop moving necessities are about satisfied and a return flow from the country is in sight. Gross railway earnings show a tendency to increase late gains, and to swell earnings for the year to totals above those of 1903. The coal trade is improving; iron and steel are active in price, and cotton textiles display more life. Finished products of iron and steel received prominent attention, and prices were advanced on billets, sheet bars, wire products and bar iron. Among the other metals the tone is quieter. Copper, after an almost uninterrupted advance, aggregating 2½ cents per pound, quieted down to 14½ cents, but further advances are believed to be possible. At times the copper market was excited and there was considerable buying activity. The market closed strong, the last quotations being 14¼ to 14⅞c. for lake; 14½ to 14¾c. for electrolytic, and 14¼ to 14⅝ for casting stock. *Bradstreet's* reports 190 business failures during the week ending November 17, as compared with 184 the week previous and 234 the corresponding week last year.

A RECORD YEAR FOR EXPORTS.—The export record of the United States in the twelve months ending with October, just presented by the Bureau of Statistics, is especially noteworthy in view of the fact that, despite the unusually small exports of breadstuffs, the total value of exports of all kinds is larger than in any preceding year ending with the date above named. Yet, despite this fact, that the value of breadstuffs exported falls $86,000,000 below the record for the corresponding period of last year and $158,000,000 below the record for the corresponding period of 1901, the total value of all merchandise exported in the twelve months ending with October is $60,000,000 greater than in the corresponding period of last year, and exceeds by nearly $10,000,000 the largest total ever known in a twelve months' period ending with October. This remarkable fact that, despite a loss of from $86,000,000 to $158,000,000 in exports of one group of articles, the grand total of exports exceeds that of any preceding year, is accounted for chiefly by a corresponding growth in the exportation of manufactures as a group and of raw cotton. Exports of manufactures in the nine months ending with September last exceed by $45,000,000 those for the corresponding period of the preceding year, and the figures of October when completed will probably show that the exports of manufactures in the ten months' period are more than $50,000,000 in excess of those for the corresponding period of the preceding year. In a large number of the important classes of manufactures the figures of recent months show a marked growth over those for the corresponding period of last year. The grand total of exports for the year is $1,483,123,631.

POWER FOR EL ORO.—Upward of $100,000, United States currency, will be expended by the El Oro Mining & Railway Company for motors, etc., to be used on its extensive gold mining property located in the famous El Oro district of Mexico. The company has signed a contract with the Mexican Light & Power Company, Limited, in which Mr. F. S. Pearson is very largely interested, whereby the latter concern will transmit electrical energy to El Oro from its Necaxa plant, 140 miles distant. The El Oro people had in view the acquisition of water rights within reach of their own mines which would enable them to generate their own power, but it has been estimated to be more advantageous to take current from the Necaxa plant, which is expected to be in operation by April—45,000 hp, most of which will be consumed in Mexico City and vicinity. The El Oro Company will discard its present steam plant. Some of the other big mining companies operating in the El Oro region are expected to conclude arrangements with the Mexican Light & Power Company for power, so that El Oro should prove a very interesting market for motors, etc., shortly.

ELECTRIC CRANES FOR SOUTH AFRICA.—An opportunity for American electric crane builders to secure a good-sized foreign contract is open in Johannesburg, South Africa, where the municipal authorities are to install two equipments of 35 tons capacity, each in the power house now under construction for operating the extensive traction system, the work of which is now under execution. The London engineering firm of Mordey & Dawbarn, 82 Victoria Street, Westminster, S. W., will furnish specifications, etc. There is not much time to spare, however, as bids have to be received by the London engineers not later than December 27.

EQUIPMENT FOR BIG GRAIN ELEVATOR.—Electrical equipment is to be installed in a large grain elevator to be built by the Hecker-Jones-Jewell Co., Produce Exchange Building, New York City. The elevator will be located at Water Street and Corlears Street and East River, New York. The main generating apparatus, including engines, has been ordered from the Allis-Chalmers Co. Mr. W. D. Gray, vice-president of the Hecker-Jones-Jewell Co., is acting as consulting engineer in the matter. His office is at 203 Cherry Street. The general contract for the structure has been allotted to the Burnett & Record Co., of Minneapolis, Minn.

AMERICANS AFTER MEXICAN LIGHTING FRANCHISES.—Mr. Sydney Sprout, of Chicago, acting on behalf of capitalists in that city, is negotiating with the municipal authorities of the city of Culiacan, State of Mazatlan, Mexico, for the concession to construct and operate an electric lighting system in that part of the world. As previously mentioned in ELECTRICAL WORLD AND ENGINEER, the Braniff interests, who represent the Westinghouse Co. in the southern republic, are also after the franchise.

EQUIPMENT FOR NEW RAPID TRANSIT POWER HOUSE.—Considerable equipment will be purchased very shortly, it is expected, for installation in the huge power house under construction at Kent and Division Avenues to be operated by the Brooklyn Rapid Transit interests. Mr. Thomas E. Murray, 53 Duane Street, New York, is acting as consulting engineer in the matter.

SYDNEY NEWSPAPER TO EMPLOY ELECTRICITY.—The plant of the Sydney *Morning Herald,* one of the largest of its kind in the antipodes, is to be equipped entirely with electricity. Some time ago a Bullock printing press equipment was shipped for installation in the Sydney plant, with the result that it has now been determined to operate all the presses by motors.

MORE EQUIPMENT FOR MEXICAN WOOLEN MILLS.—Mexican advices state that application has been made to the Mexican Government by Mr. D. Stuarte, of Mexico City, acting as representative of the San Ildefonso Woolen Mills, for the necessary permission to utilize 1500 liters of water per second in order to develop more electric energy for the purpose of operating the mills.

POWER IN SOUTH CAROLINA.—The Broad River Light & Power Company, which was incorporated at Broad River, near Union, S. C., by J. L. David, J. A. Dingle and others, with capital of $1,000,000, is to supply electric power to the cotton mills and other industries about Union. Other mills may be organized as an outcome of the power company.

NEW GRAPHOPHONE PLANT.—The American Graphophone Company, of Bridgeport, has awarded the contract for the erection of an additional foundry. It will be a brick and steel structure, 63 by 148 feet. This is the last of the series of factory buildings which the company planned some time ago and which, when completed, will make a spacious plant.

EQUIPMENT FOR NEWARK OFFICE BUILDING.—A large office building is to be constructed at Newark, N. J., by the Mutual Benefit Life Insurance Company. Pattison Brothers, Flatiron Building, New York, will be the engineers in charge of the electrical installation. Fully a dozen motors of various sizes will be put in for different purposes.

LIGHTING SYSTEM FOR AUCKLAND, NEW ZEALAND.—A municipal lighting system is to be installed in Auckland, one of the most prominent cities in New Zealand, which has already an extensive electric traction system, built by the London interests of J. G. White & Co., New York City. The work will entail an expenditure of about $400,000.

EQUIPMENT FOR BUSH MODEL FACTORY.—A large model factory is to be built by the Bush Co., Ltd., 117 Pearl Street, New York City, at Thirty-six and Thirty-seventh Streets and Second to Third Avenues, Brooklyn. Mr. William Higgins, Park Row Building, is the architect. Mr. E. P. Goodrich has been appointed consulting engineer.

EQUIPMENT FOR HEBREW ORPHAN ASYLUM.—A fair-sized lighting equipment will be installed in the Hebrew Orphan Asylum now undergoing construction at Ralph Avenue and Dean and Pacific Streets, Brooklyn. Mr. C. O. Mailloux, 76 William Street, New York City, is the consulting engineer.

LIGHTING SYSTEM FOR CORONEL SUAREZ.—An electric lighting system is to be built at Coronel Suarez, a Chilian town of some 6,000 population, and in the vicinity of which are large coal mines. The Electric Light & Water Works Company, of that place, will let the contracts for the equipment very shortly.

WESTERN TELEPHONE SYSTEM FOR MANILA.—The Western Electric Company has secured the contract for the telephone system to be operated by the Manila Railway, Light & Power Company, Philippine Islands. The lines will be about 40 miles long.

ELECTRICITY IN SOUTHERN MINE.—The Jeffrey Manufacturing Company, of Columbus, Ohio, has recently equipped Slope No. 3, Pratt Mine, of the Tennessee Coal, Iron & Railroad Company, near Enslie, Ala. The first haulage was, of necessity, a rather crude one and was replaced several years ago by an endless-rope arrangement with a daily capacity of 1,100 tons. When the new management acquired possession of the Tennessee Company's properties, it was seen that the territory available to the No. 3 mine more than guaranteed returns for the expenditure of a sufficient sum to install a haulage system, combining the most modern and efficient use of electricity—capable of delivering 2,400 tons into railroad cars in a day of 9 hours' work, at a much less cost per ton. To install this haulage arrangement it was necessary to discard practically all of the former machinery and equipment, making the plant an entirely modern one. The double tracks in the slope and main headings essential with an endless-rope arrangement, were relaid with forty-pound steel rails. Four 6-ton and two 10-ton Jeffrey electric mine locomotives are employed in the mine to gather coal and deliver it in mine cars to the bottom of the haulage, where track facilities are provided for the collection of 20-car trips. When a trip of empties reaches the bottom, it is quickly passed into the mine proper and the loaded trip attached to the rope, the change requiring less than a minute. Each of the motors is easily capable of delivering 12 trips or 20 cars each to the chain in a day's work—each car holding 3,300 pounds of coal. Under the old system, 35 mules with a driver for each animal and a large number of chainers to attach the cars to the rope, were employed.

SHEPHERD ENGINEERING COMPANY.—Among recent installations by the Shepherd Engineering Company, Franklin, Pa., are a 600 hp, four-valve, cross-compound engine to the Eberhard Faber Pencil Company, of Brooklyn, N. Y.; two 250 hp engines, each direct-connected to two generators, installed in the Russia Building, Boston, Mass., and one engine direct-connected to Crocker-Wheeler generator, at Fort Andrew, Boston Harbor. Also recent orders booked, two engines for Brandon Hall, Beacon Hill, Boston, Mass.; three engines for the new office building, Columbus Savings & Trust Company, Columbus, O.; two engines to the Arbuckle-Ryan Company, Toledo, O., for installation at the plant of the Northwestern Ohio Bottle Company, and one engine to the Joyce-Cridland Com,-pany, of Dayton, O.

CONTRACTS FOR "WONDERLAND."—Mr. Andrew J. Cobe, president of the Corporation Liquidating Company, Park Row Building, New York City, who promoted the big amusement enterprise to be known as Wonderland, situated at Two Hundred and Eighteenth Street and Broadway, New York, has awarded the contract for construction to the Wells Brothers Co., of Twenty-first Street and Fifth Avenue. The contract involves $1,500,000. The contract for electrical work was awarded to Mr. Harry Alexander, No. 20 West Thirty-fourth Street. Mr. Cobe expects to have the new Wonderland ready for the opening of the summer season, which, of course, in Manhattan, will be several weeks before the Coney Island season opens.

MINE ELECTRIC PUMPS.—The Ward Shaft Association, which owns mining ground nearly a mile in length in the middle of the Comstock Lode at Virginia City, Nev., has closed contracts aggregating $80,000 for an electric pumping plant to drain its mines through the Ward shaft. The contract for the two 800-hp induction motors was awarded to the Westinghouse Electric & Manufacturing Company. The International Steam Pump Company, Charles C. Moore & Co., Pacific Coast agents, was the successful bidder on the two first-motioned electrically driven pumps. Each of the units is to have a capacity for lifting 1,600 gallons of water per minute against a pressure equivalent to a height of 1,500 feet.

EQUIPMENT FOR HOUSTON STREET FACTORY.—Considerable lighting and power machinery will be required for installation in a light factory building to be built at 97-103 East Houston Street. Mr. C. O. Mailloux will act as consulting engineer on the work. The plant will be of 325 kw capacity. There will be one generator of 150 kw capacity, direct connected to a 225-hp engine; one generator of 100 kw capacity for direct connection to a 150-hp engine, and a 75-kw unit direct connected to a 110-hp engine. There will also be a number of motors employed for driving various machinery.

THE NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., report recent shipments of cranes as follows: Bethlehem Foundry & Machine Company, 4 ton electric crane, 43-ft. span; Public Service Corporation of New Jersey, 10 ton, 39-ft. span; New York Butchers' Dressed Meat Company, 12 ton, 39-ft. span; Union Metallic Cartridge Company, 12 ton, 30-ft. span; People's Power Company, Rock Island, 10 ton, 50-ft. span; Duluth Street Railway Company, 20 ton electric crane, special. They report a much better outlook for business. This company is also putting on the market some electric trolley hoists.

SOME DE LAVAL TURBINE ORDERS.—A 225-hp De Laval dynamo set has been ordered, also two 10,000,000-gallon De Laval turbine centrifugal pumping equipments, by the Public Water Company, of Ottumwa, Iowa. The Grand Rapids (Mich.) Gas Company has ordered two De Laval turbines to be used for driving Sirocco blowers, built by the Sirocco Engineering Works, of Belfast, Ireland. These equipments will each be capable of taking care of 150,-000 cu. ft. of gas per hour. These orders were secured through the Turbine Engineering Company, Whitehall Court Building, New York.

BIG MEXICAN WATER POWER PROJECT.—Mr. David Reyes Retana, of Mexico City, according to information to hand from that part of the world, is endeavoring to obtain a franchise from the Mexican authorities to utilize some 60,000 liters of water per second from the Mescala or Balsas River, State of Guerrero. The power will be taken between a point where the Palmilla River enters and another point situated about 30 miles distant. The electric energy generated will be used for lighting and general power purposes for several miles around.

BIDS WANTED.—The Ozark Lead Company, Joplin, Mo., is in the market for electrical equipment for its mines at Webb City, including one 100, two 75 and one 15 hp alternating motors, together with transformers, arresters, switchboards and distributing circuit. The City of Dallas, Tex., is in the market for an electric light plant of from 500 to 1,000 arc lights, including engines, boilers, generators, dynamos and other equipment. The bids will close December 6.

PROPOSED CHICAGO SUBWAY.—Mr. G. W. Jackson has submitted to the Council plans for a down-town subway system in Chicago, costing $18,577,313, for the use of street cars. It will be remembered that Mr. Bion J. Arnold has already prepared for the city a most elaborate and exhaustive report, embodying various plans for relieving the pressure of passenger traffic and providing for the future.

PLANT FOR ANOTHER BIG APARTMENT HOUSE.—A large apartment house to cost upward of $1,000,000 is to be built between Seventy-third and Seventh-fourth Streets and Central Park West, New York, and a good-sized electric lighting plant will be installed. Boehm & Conn, 31 Nassau Street, will construct the building. Clinton & Russell, same address, are the architects.

EQUIPMENT ORDERS FOR BINGHAMTON.—The Binghamton (N. Y.) *Daily Press* building is to be equipped for lighting purposes with a Westinghouse generator to be direct connected to an engine built by the Payne Engineering Company, New York City. Mr. C. O. Mailloux, of 76 William Street, is the consulting engineer on the work.

NEW OFFICE BUILDING FOR BROOKLYN HEIGHTS RAILROAD.—An office building is to be built by the Brooklyn Heights Railroad Company, at Clinton and Remsen Streets, Brooklyn. The electrical engineering and contracting firm of Pattison Bros., Flatiron Building, is to act as engineers for the electrical installation work.

EQUIPMENT ORDERED FOR NEW GOELET BUILDING.—The Turbine Engineering Company, Whitehall Court Building, New York City, has secured a contract for lighting equipment to be installed in the building at 114-116 West Thirty-ninth Street, being erected by the Goelet interests.

MORE EQUIPMENT FOR WOOLBRIDGE BUILDING.—The Woolbridge Co., of which Mr. J. G. Phelps Stokes is president, is to instal more electrical equipment in its plant in the Woolbridge Building, 100 William Street, which is to be added to. Howells & Stokes are the architects.

EQUIPMENT FOR UP-TOWN APARTMENT HOUSE.—An apartment house will be built at One Hundred and First Street and Fifth Avenue, New York City, by Mr. Herman Wronkow, 23 Union Square, and an independent lighting plant will be put in.

LOWEST BIDDERS FOR PUBLIC SCHOOL EQUIPMENT.—W. M. Sheehan & Co., of 136 Liberty Street, are the lowest bidders for the equipment to be installed in No. 62 Public School, Hester Street, New York City. Their tender was $19,560.

BELL TELEPHONE OUTPUT.—The net output of the American Telephone & Telegraph Company increased 1,114 instruments for the month of October, making an increase of 49,410 instruments since January 1.

PLANT FOR NEW ZEALAND.—The Richardson Engineering Company, of Hartford, Conn., has secured a contract for the installation of a private lighting plant at Blackhead Station, New Zealand.

TELEPHONE CONSOLIDATION.—Articles of merger and consolidation have been filed by the Winchester Telephone Company of Virginia and the Cumberland Valley Telephone Company of Baltimore.

General News.

THE TELEPHONE.

NOME, ALASKA.—The Alaska Telephone & Telegraph Company has taken over the Nome telephone system and the Boyd Long Distance telephone line. A number of extensions will be built.

HOT SPRINGS, ARK.—The Hot Springs & Point Cedar Telephone Company has been chartered by the State, capital $2000. The officers are L. B. Estes, C. H. Easley, H. Hardy and Wm. Lambert. It is proposed to build a line from Hot Springs to Friendship with a branch from Chaney Church to Point Cedar.

STOCKTON, CAL.—The Pacific States Telephone Company is reorganizing the telephone system in this city. All the outside construction is to be rebuilt; an additional story has already been built to its exchange building on the corner of San Joaquin and Channel Streets, fitted with new multiple exchange boards to accommodate some 3000 subscribers, while the common battery telephones will replace the old storage battery system. When completed the telephone system here will be one of the most modern on the Coast.

TORONTO, CAN.—The Rainy River International Telephone Company, of Rainy River, has been incorporated with a capital stock of $25,000. The directors are D. Robertson, P. T. Roberts, J. A. Mathieu, H. Williams, P. A. Smith and H. J. F. Sissons.

LONGMONT, COL.—The Colorado Telephone Company is preparing to rebuild the entire system of wire work in this city. When this is done new switchboards will be installed.

COLORADO CITY, COL.—The El Paso Telephone Company has been established with a capitalization of $500,000, for the purpose of building a telephone system through the counties of El Paso, Teller, Fremont, Pueblo, Douglas and Denver. The principal organizers of the company are M. H. Spere, N. B. Hames and C. D. Taylor.

DENVER, COL.—At a special meeting of the stockholders of the Colorado Telephone Company it was voted to increase the capital stock from $5,000,000 to $10,000,000. The money secured from this source will be used to extend the lines into Nebraska, Kansas and other States east of here, besides the lines in Colorado, for the purpose of providing long-distance connections between Denver, Omaha, St. Louis, Chicago and other middle-states cities.

AUBURN, ILL.—W. H. Ramsey, independent telephone promoter and associated with the Interstate Telephone Company, has been granted a franchise by the City Council here securing to him the right to install underground telephone cables throughout the city.

MARION, IND.—The Central Union Telephone Company, of Marion, is building another trunk line between Fairmount and Marion for the use of the Citizens' Telephone Company of Fairmount.

FLORA, IND.—At a meeting of the stockholders of the new co-operative telephone company at this place it was voted to accept the proposition for the sale of the system to a new company. The men who compose the new company are Dr. F. P. Lyons, Dr. E. L. Peter, Dr. W. E. Callane and others.

RUSHVILLE, IND.—At the recent annual meeting of the Rushville Co-operative Telephone Company, the following directors were elected: H. E. Barrett, W. D. Root, B. L. McFarlan, T. M. Green. The secretary's report shows receipts for the year in excess of $15,000, with disbursements of $14,664, the balance being $440.13.

POE, IND.—The officers and the members of the companies operating the rural telephone lines centering in this town have held a meeting for the purpose of discussing the project of connecting the various rural telephone lines. A connection will be made with Fort Wayne. A switchboard is being secured and will be placed in operation.

LAFAYETTE, IND.—The independent telephone plant at Bunker Hill has been sold out to the Bell Telephone Company. It is thought that this is only the starting of a movement by the Bell people to buy out the independent telephone companies over the state and gain the prestige the company used to have in Indiana. The plant was installed two years ago and has been doing a large business ever since.

ROCKWELL, IA.—The Iowa Telephone Company will build a line to Thornton.

DES MOINES, IA.—The Rockwell Telephone Company has been incorporated with a capital stock of $25,000.

DES MOINES, IA.—The Carroll Township Mutual Telephone Company has been formed, capital $4992. Incorporators: James Potter and others.

MILFORD, IA.—The Midland telephone line here is being extended to the northwest and arrangements are being made to connect with the exchange at Lake Park and Spirit Lake.

BLAKESVILLE, IA.—The Blakesville Farmers' Mutual Telephone Company has been incorporated with a capital stock of $5000. C. W. Smith is president and Martin Rindernecht, secretary.

VINCENT, IA.—E. M. Martin, of Webster City, has just completed arrangements with the people of this place to install a new telephone exchange. Work will commence at once and he expects to have the exchange operating by Dec 10.

TOPEKA, KAN.—The Whitewater Telephone Company has been incorporated with a capital stock of $15,000.

BANGOR, ME.—The Automatic Telephone Company's petition for rights has been granted, and an order to that effect passed.

MENOMINEE, MICH.—The Michigan State Telephone Company has decided to build a line from here to Cedar River at once.

MARSHALL, MICH.—The Marshall Telephone Company's stockholders have voted to increase their stock from $15,000 to $50,000. The directors are V. A. Leppe, L. C. Miller and others.

LAMBERTON, MINN.—The Minnesota Central Telephone Company is figuring on extending rural lines next spring.

WALKER, MINN.—The Cass County Mutual Farmers' Telephone Company is talking of extending its line from Motley to this place.

LAKE CRYSTAL, MINN.—Henry Graif sold his local telephone system in this city to the Blue Earth Telephone Company for $6100.

NORTHFIELD, MINN.—The Northfield Telephone Exchange Company contemplates in the near future making extensive improvements and repairs.

GOOD THUNDER, MINN.—A new farmers' mutual telephone company is in contemplation from the west. Its name is Pride Telephone Company.

MOTLEY, MINN.—The Enterprise Automatic Telephone Company, of this place, has secured the contract for constructing a telephone system in the village of Grey Eagle.

WOOD LAKE, MINN.—The citizens of Wood Lake are making arrangements to organize and put in active operation a rural telephone company. The shares will be sold at $50 each, and many farmers are expecting to become subscribers. It is proposed to have the line run through the several townships adjoining Wood Lake.

ARCHER, NEB.—The Archer Independent Telephone Association has been incorporated with a capital stock of $50,000. The incorporators are A. J. Harshberger, J. B. Templin and others.

TROY, N. Y.—The Johnsonville Telephone Company has been incorporated with the Secretary of State. The capital stock is $500, and the directors are Jay D. Van Wirt, C. Ira Haner, Ernest H. Abbott, Clarence M. Herrington and Clarence E. Akin, of Johnsonville, and Hiram Sherman and E. D. Herrington, of West Hoosick.

ORISKA, N. D.—The proposed telephone exchange will be installed here this fall.

GRAND FORKS, N. D.—The Tri-State Telephone Company is constructing a line from here to Moorhead.

MARIETTA, OHIO.—The Marietta Telephone Company will increase its capital stock from $50,000 to $100,000.

BLANCHARD, OHIO.—The Farmers' Mutual Telephone Company has authorized the erection of a line leading from Benton Ridge to Pandora over the Benton Ridge road.

NEW LYME, OHIO.—The New Lyme Telephone Company has been incorporated with a capital stock of $600. The incorporators are M. A. Smith, F. F. Fitch and others.

AKRON, OHIO.—The Citizens' Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are Jas. W. Stearns, Richard H. Bell and I. D. Eckerson, of Akron.

COLUMBUS, OHIO.—The Franklin Telephone Company will soon begin the extension and improvement of its lines through this county. An effort will be made to have a great deal of this work done by spring.

ELYRIA, OHIO.—The Elyria Telephone Company is just completing its new multiple tap cable system. It has installed several thousand feet of underground cable and more than one hundred thousand feet of aerial cable. It has also lately installed a new multiple common-battery switchboard of the central energy type. It is the intention of the company to install several different kinds of service, such as individual service, party line service and measured service, which will apply to both business and residence telephones. The engineering and management of the plant is under the supervision of Mr. L. W. Stanton, consulting and constructing engineer, of Cleveland, Ohio.

WEST CHESTER, PA.—A new telephone system is being installed on the Lenape and Kennett branches of the West Chester Street Railway. There will be telephone boxes placed at intervals along the road.

RAYSVILLE, PA.—A number of independent telephone organizations, including those in Orwell, Warren Centre, Neath and Jackson Valley have consolidated, and a company has been formed to be known as the People's Co-operative Telephone Company, the officers of which are as follows: President, D. Cowles; secretary, B. H. Phelps; treasurer, Hugh Jones. It is intended to extend to the connections south of Stevensville joining with the Rush system.

CHARLESTON, S. C.—A charter has been issued to the Colleton County Telephone Company. The capital stock of the company is $5000 and the officers are T. B. Whaley, president, and W. T. Gray, treasurer.

HENDERSON, TENN.—A movement is on foot for the purpose of organizing an independent telephone company.

TACOMA, WASH.—The Waitsburg Rural Telephone Company has been incorporated by J. W. Morgan, president; Gus Vollmer, vice-president; W. B. Brooke, secretary, and A. W. Phillips, treasurer.

SPOKANE, WASH.—A company has been formed for the purpose of supplying musical programmes by means of the telephone. The company is known as the Pacific Telharmonic Company, with headquarters at Seattle, and is stated to have secured the exclusive rights west of the Rocky Mountains for the use of a device which enables a musical programme to be simultaneously distributed to any number of circuits. The officers of the company are: President, C. J. Smith; vice-president, John J. McGraw; treasurer, J. W. Clise; secretary, F. A. Wing; general manager, T. O. Abbott.

EAU CLAIRE, WIS.—The Chippewa County Telephone Company will make two new extensions.

ARGYLE, WIS.—A. G. Hawley has purchased the Monroe stock in the Argyle Telephone Company and now has full control.

DODGEVILLE, WIS.—Five farmers' telephone companies propose to establish a farmers' exchange here. John Hughes, of Rewey, Wis., is interested.

ELECTRIC LIGHT AND POWER.

PHOENIX, ARIZ.—The Green River Power, Land & Irrigation Company has been incorporated, with principal office at Phoenix, and a capital of $500,000. Incorporators: P. W. Barclay and Geo. C. Plummer.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company has increased its capital from $300,000 to $1,000,000.

SEARCY, ARK.—The Black Hawk Electric Company, of Davenport, Ia., has secured the contract for constructing the municipal electric light plant here for $19,105.

BRINKLEY, ARK.—The Farrell Light, Heat & Water Company, of Brinkley, has been incorporated with a capital stock of $50,000. The officers are J. J. Farrell, president and treasurer; H. W. Boyle, vice-president, and W. S. Kilpatrick, secretary.

MODESTO, CAL.—The City Board of Trustees has accepted the proposition of C. T. Tullock to supply the city with electric lights.

ALAMEDA, CAL.—New machinery will be added to the municipal electric light plant, including a turbo-generator and an engine and dynamo.

SAN FRANCISCO, CAL.—The Arcata electric light plant in Arcata, Cal., has been purchased by A. H. Cheney. It is said that $20,500 was paid the Humboldt Manufacturing Company for the plant, pole lines and franchise.

LOS ANGELES, CAL.—The Oxnard Light & Water Company has purchased a tract on which it will build a large brick power house for a new and up-to-date lighting plant. A 200-hp heavy duty engine has been ordered, with boiler plant, dynamos, etc.

SAN FRANCISCO, CAL.—The report that the California Gas & Electric Corporation had placed orders for three large generating units, each consisting of a Snow gas engine direct-connected to a 4000-kw, 3-phase generator, has been confirmed. It also transpires that this is merely a reserve plant to the water power transmission lines of the corporation in connection with a contract just signed, under which the United Railroads of San Francisco is to be supplied with all of the power necessary for the operation of its lines.

NEW CASTLE, DEL.—The Delaware Water & Improvement Company has been granted a franchise to operate an electric light and water plant in New Castle.

WASHINGTON, D. C.—Bids will be received Nov. 29 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, League Island, Pa.; Washington, D. C., and Naval Academy, Annapolis, Md., a quantity of incandescent lamps, wattmeters, Electra carbons, wire, conduit and fittings, and miscellaneous electrical supplies. Bids will also be received Dec. 13 for furnishing at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of wattmeters, volt-meters, conduit, engine indicators, copper wire, single and twin lighting wire, fuse wire, electric clusters and miscellaneous electric supplies. H. T. B. Harris, Paymaster-General, U. S. N.

MONTICELLO, FLA.—The Council has contracted with J. M. Henry, Jr., and C. L. Thompson for an electric plant for this city.

GREENSBORO, GA.—The citizens have voted to issue bonds for the construction of an electric light plant.

THOMASVILLE, GA.—The town of Thomasville has voted $35,000 for a municipal electric lighting plant. This action means a defeat for the bond proposition and a victory for municipal ownership.

CAIRO, ILL.—The Anna electric light plant has been destroyed by fire.

MACKINAW, ILL.—Fire destroyed the electric light plant here. The loss is $10,000.

PEORIA, ILL.—City Electrician Hall has submitted estimates that the city can place fire and police wires in underground conduits at a cost of $10,000.

SPRING VALLEY, ILL.—The Spring Valley Lighting & Power Company, Spring Valley, has been incorporated with a capital of $100,000. Incorporators: John McFadden, R. Reichardt and H. E. Brown.

EAST ST. LOUIS, ILL.—The Illinois Illuminating Company has asked for the passage of ordinances giving it the right to string wires and erect poles in East St. Louis to furnish electricity for light and power purposes.

ALTON, ILL.—Announcement is made that the property of the Alton, Granite & St. Louis Traction Company, comprising the street railway, public lighting and heating utilities in Alton, will be formally transferred Dec. 1 to the Alton Gas & Electric Company, which has been organized to take charge of the property.

COALGATE, I. T.—The City Council has granted a franchise to the Coalgate Company, of this city, to construct and operate an electric light system.

SIOUX CITY, IA.—The citizens voted Nov. 8 to grant a franchise for a heating and electric light plant to Edw. Tilden, of Chicago, Ill.

TOPEKA, KAN.—The Edison Electric Illuminating Company has petitioned the City Council for a franchise.

CROWLEY, LA.—The municipal lighting plant will install a 200-kw dynamo of 140 cycles, 1100 volts.

SHREVEPORT, LA.—The Shreveport Gas, Electric Light & Power Company will make a thorough renovation of its lines.

BLAINE, ME.—The Mars Hill & Blaine Electric Light Company has been organized at Blaine with $10,000 capital stock, of which nothing is paid in. The officers are: President, Almon O. Nutter, of Mars Hill; treasurer, Geo. W. Young, of Blaine.

GREENFIELD, MASS.—The village of Greenfield is now lighted by electricity transmitted from Gardner Falls.

SOMERVILLE, MASS.—At a meeting of the Somerville aldermen recently the adoption was secured of an order authorizing the mayor to petition the Legislature for a bill to require the placing underground of all electric wires except street railway trolley wires and long-distance telephone wires in Somerville.

MORENCI, MICH.—A franchise has been granted by the Council to Dow & Fisher for the lighting and heating of the village with gas or electricity.

HOUGHTON, MICH.—The Houghton Common Council will hold a meeting for the purpose of awarding the contract for electric pumping machinery.

MELROSE, MINN.—It was voted Nov. 8 to construct water works and an electric light plant.

GEORGEVILLE, MINN.—Peter Halseth is interested in the construction of an electric light plant.

WASECA, MINN.—The City Council may possibly purchase machinery and make some repairs to the city light plant.

MONTGOMERY, MINN.—J. E. Anderson and S. A. Votapek have petitioned for a franchise for an electric light plant.

WINONA, MINN.—The Minnesota Light & Power Company has been formed in this city with a capital of $75,000. H. M. Lamberton, Jas P. Laverty, Fred B. White and others are the incorporators.

PHILLIPS, MONT.—The Papoose Mining Co. has been incorporated to build plants for the generation and transmission of electricity power, and to furnish power to mines, mills and smelters; capital, $20,000. Directors: Chas. Whitcomb, of Zortman; Ben. D. Phillips, of Phillips; Robt. J. Coburn, of Brookside, and Wm. F. Word, of Helena.

ST. JOSEPH, MO.—Sealed proposals will be received for constructing a building for central electric plant in accordance with the plans of Ben W. Trunk, architect, John C. Landis is president of the Board of Public Works.

ST. JOSEPH, MO.—Bids for the construction of the proposed city electric lighting plant will be advertised here.

JEFFERSON CITY, MO.—At the special election held Nov. 15 on the granting of a 20-year franchise to a Chicago syndicate to furnish electric and gas light to the city, the proposition was carried. This ratifies the sale of the plant to the Chicago people, the consideration being $100,000. The terms of the franchise make it incumbent upon the new company to improve the service and reduce the schedule of prices which have prevailed.

GRAND ISLAND, NEB.—The City Electric Light & Ice Company will install an additional boiler, generator and engine and build five miles of pole line.

PLYMOUTH, NEB.—The Nebraska Lighting Company has been formed here with a capital of $100,000. Chas. C. Parmele is president. A deed is reported to have been filed transferring the Plattsmouth Gas & Electric Light plant to the new corporation. Extensive improvements are to be made at once.

LINCOLN, NEB.—Contracts for the new lighting plant for the city of Lincoln have been let as follows: Two 150-hp engines and three boilers, Murray Iron Works, Burlington, Ia.; electric generators, Gilbert Wilkes & Co., Denver, Col.; boiler feed pumps, Sunderland Roofing & Supply Co., Omaha, Neb.; water heater, Hoppes Mfg. Co., Springfield, Ohio.

TRENTON, N. J.—The Monterey Water, Sewer & Power Company, with an authorized capital of $4,000,000, has been incorporated in New Jersey for the purpose of constructing water and power plants and building sewers. The incorporators are J. J. Jermyn, Charles B. Wells, James J. Williams, George S. Brooks, James H. Torrey, Cyrus D. Jones, Charles H. Weston and P. G. Brooks, all of Scranton, Pa.; James D. Stecker, Jermyn, Pa., and Lewis B. Dailey, East Orange, N. J.

MT. VERNON, N. Y.—The directors of the Westchester Lighting Company have under consideration extensive improvements in the outlying territory. F. A. Stratton, of Mt. Vernon, is president.

NEWARK, N. Y.—The Village Board has entered into a contract with the new Newark Light, Heat & Power Company to light the village streets for 5 years at $85 per lamp per year.

SCOTTSVILLE, N. Y.—The Scottsville Electric Light & Gas Company, of Scottsville, has been incorporated, capital $30,000. Incorporators: J. W. Salyerds and D. C. Salyerds, Scottsville, and M. E. Lewis, of Rochester.

GOUVERNEUR, N. Y.—The Village Trustees have contracted with the Oswegatchie Light & Power Company for lighting the village for 5 years at $60 per arc light per year for the first 2 years for midnight service only, and at $75 per light per year for the remaining 3 years for an all-night service.

MIDDLETOWN, N. Y.—The lands, properties, rights, privileges and works of the Orange County Gas & Electric Light Company, of Middletown, were sold at foreclosure sale Thursday, Nov. 10, the successful bidder being Philip N. Jackson, of Newark, a bondholder, and who represented other bondholders. The price at which the property was sold was $46,100. The foreclosure was brought by second mortgage bondholders.

TOLEDO, OHIO.—The Wabash Railroad has plans for the equipment of the crosstown line with electric motive power and a large electric power house will be erected south of Cherry Street.

GUTHRIE, OKLA. TER.—The City Council has granted a franchise to the Guthrie Electric Light & Power Company for a period of 20 years.

MILTON, ORE.—The flume for the City of Milton power plant and electric light station will be completed in a few days, and the 18-inch turbine wheel will be placed in position. The flume is four feet in diameter and 1600 feet long, taking water from the Walla Walla River. Only 128 horse-power will be generated, but the flume will be extended a quarter of a mile farther and 480 horse-power generated as the city grows and calls for more power. The new power house is now finished.

PITTSBURG, PA.—It is stated that the new Duquesne Light Company will expend about $2,500,000 on the proposed electric light plant.

WOMELSDORF, PA.—The citizens have voted to issue $8000 bonds for an electric light plant. W. W. Lengel is secretary of the Borough Council.

WALHALLA, S. C.—The Oconee Water, Light & Power Company proposes to construct a plant to cost from $100,000 to $120,000. No engineer has been selected as yet.

COLUMBIA, S. C.—A commission for a charter has been granted to the Broad River Light & Power Company, situated near Lockhart. The capital stock of the company is $1,000,000.

BELTON, S. C.—It is reported that the Belton Power Company is about to commence work on the construction of the power plant on Saluda River. J. E. Sirrine, of Greenville, S. C., is in charge.

CARTHAGE, TEX.—A complete reconstruction of line is contemplated for the electric light plant, of which J. C. Whitney is proprietor.

TEXARKANA, TEX.—The Texarkana Gas & Electric Light Company will install a new alternating current generator and Corliss engine, direct connected.

ST. ALBANS, VT.—The city is now being lighted with electricity generated at the power plant of the Vermont Power & Mfg. Company at Fairfax Falls. The construction of this plant has been under way for the past two years under the supervision of Walter H. Vorce, the manager of the company. The price for light under the new management has been reduced to 60 per cent. of the old rate. A sub-station has been erected outside of the city limits on South Main Street.

MANCHESTER, VA.—Shirley Carter, Chairman of the Electric Light Committee, has submitted a report to the Council recommending that the city own the electric light plant. The present contract expires in December.

RICHMOND, VA.—At a conference of the Committees on Finance and Electricity on Nov. 10 a sub-committee of five was appointed, with authority to employ an expert electrical engineer to prepare estimates of cost, location, etc., for a municipal electric light plant.

MARTINSVILLE, VA.—An option has been secured on the land and water power owned by R. J. Reynolds on the south side of Smith River, the same to be used as a site for a municipal electric light plant. The question of bonding the town for $60,000 to pay for site and construct the plant, will probably soon be voted upon. J. R. Gregory is City Engineer.

NORTH YAKIMA, WASH.—It is stated that the Water & Light Company will construct a power plant near the intake of Wapatox ditch to generate electricity for this city and the electric railway.

CHEWELAH, WASH.—J. G. Kulzer, a prominent sawmill man of Valley, Wash., is making arrangements for the development of 600-hp of water which he owns near here. He intends building an electric light and power plant with which to supply light and power for his own lumber plant as well as the nearby towns. He will begin work on the enterprise as soon as he can make arrangements for disposing of his surplus light and power.

MORGANTOWN, W. VA.—Prof. C. R. Jones has submitted to Council preliminary plans for a municipal electric light plant. He estimates the cost at $31,660.

MARKESAN, WIS.—The citizens have voted to issue bonds for an electric light plant.

CHETEK, WIS.—The city is considering the installation of an electric light plant, and will utilize the local water power.

MAUSTON, WIS.—The Mauston Electric Service Company has purchased the electric light and telephone company's plant. Extensive improvements will be made.

DE PERE, WIS.—For electric pumping the city of De Pere, Wis., has let contracts for two 40-hp motors to the Northern Electrical Mfg. Co., of Madison, Wis.

CORLISS, WIS.—Application has been made by the Brown-Corliss Engine Company, of this city, for permission to establish water-works, electric light, heat and power plant here, to cost from $25,000 to $30,000.

THERMOPOLIS, WYO.—It is proposed to rebuild the plant of the Thermopolis Electric Light Company, recently burned, at a cost of $8000. Mr. Ira E. Jones is interested.

ORILLIA, ONT.—The town of Orillia received a renewal of electric energy from Ragged Rapids on Nov. 10, after being deprived of the service for about seven months, through the breaking away of the dam at the power house last spring. There will now be available in Orillia about 1000 horse-power for lighting and power purposes. The power plant, when completed, will cost the town upward of $300,000, and will have a capacity of 3000 horse-power.

TORONTO, ONT.—It is now stated that Toronto is not likely to receive Niagara power before the autumn of 1905. The cables of the Electric Development Company and the necessary apparatus for transmission will be completed some two years before the company is in a position to generate power at the Falls. It is understood, however, that one of the other two power companies will be able to supply the Development Company with power early next fall, and it is this power that will first reach the City of Toronto from Niagara.

THE ELECTRIC RAILWAY.

SAN JOSE, CAL.—A survey is being made for an electric railway to Lick Observatory on Mount Hamilton. Two routes will be surveyed, one by way of Alum Rock Park and the other by way of Evergreen. The length of the line will be 20 miles and the estimated cost is $500,000. K. P. Fisher is in charge of the survey.

DENVER, COL.—The statement is made that the Denver-Boulder Interurban Railway Company has floated $1,000,000 of bonds in the East, to secure the construction of its proposed electric railway system. J. R. McKinnie, of Denver, is the president of the company.

PLAINVILLE, CONN.—Plans are being developed for the building of an electric power plant at North Sterling for the Providence & Danielson Street Railway Company. The project involves the construction of a dam, 36 feet high, across Quaduck Brook. The company proposes to build a branch trolley line from Foster Centre, R. I., to Plainfield.

ATHENS, GA.—Preliminary arrangements are being made for the construction of a railway from Athens to Savannah. The project is in the hands of W. H. Lynn, New York, and Cecil Gabbett, Statesboro, Ga.

GENESEO, ILL.—The Rock River Traction Company will complete all engineering details of its proposed construction this winter so as to be able to begin active construction work early in the spring.

QUINCY, ILL.—Fred Norlin, with a corps of engineers, is now making a preliminary survey for an interurban railway from Hannibal, Mo., to Quincy, Ill. For further information address Fred Norlin, 711 Chicago Opera House Block, Chicago, Ill.

LITCHFIELD, ILL.—The Secretary of State has issued a license to the Litchfield Traction Company to incorporate. The capital stock is placed at $5000. The incorporators are Charles B. Munday, Jr., M. J. Buscher and G. L. Settlemire. The object of the company is to operate a street railway.

LOGANSPORT, IND.—The Indianapolis, Logansport & South Bend Traction road has been organized with a capital stock of $10,000. Directors: J. M. Caulfield, G. H. Leslie and others.

IOWA CITY, IA.—The Iowa City & Davenport Interurban Railroad Company has been incorporated, capital $100,000. Hon. Milton Remley, C. S. Ranck, Stephen Bradley and others are at the head of the company.

DAVENPORT, IA.—The managers of the Ottumwa Telephone & Electric Company say that they are going to parallel the Rock Island Railroad with a trolley line across the State.

DAVENPORT, IA.—The Iowa City & Davenport Interurban Railway Company has just been incorporated to construct an interurban railway between Davenport and Iowa City. The incorporators are Hon. Milton J. Remley, Stephen Bradley, George W. Koontz, C. S. Wright and George E. Remley, of Iowa City, and a number of Chicago and Eastern gentlemen who represent the financial interests likely to take an interest in the line. The initial capital provided for is $100,000.

SPRINGFIELD, ILL.—Surveys are being made for an interurban electric railway from Springfield via Petersburg to Beardstown. H. H. Colby is president; C. W. Houghton, vice-president; R. E. Bone, secretary and treasurer, all of Petersburg. The name taken is the Springfield, Beardstown & Quincy Interurban Railway Company.

TOPEKA, KAN.—The Wellington & Cowley County Traction Company, with $500,000 capital, has been granted a charter. The incorporators are George H. Hunter and C. A. Gambrill, of Wellington; H. F. Harbaugh, of Rome; John Blattner, of Rome; L. H. P. Northrup, C. A. Scruton and S. P. Gould, of Arkansas City.

MONROE, LA.—The Mayor has been authorized to secure the services of an engineer to prepare plans and specifications for the construction of an electric railway here. The plan is for the municipality to build and operate the line.

BANGOR, ME.—The Eastern Traction Company will perfect all arrangements this winter for beginning the construction of its proposed line early next spring. All grants have been secured by the company, including the right to build in Bangor.

BANGOR, ME.—The Penobscot Central Railway was bought at forced sale by auction here, Nov. 1, by Charles E. Fisher, of Gloucester, Mass., for $174,000. Mr. Fisher is understood to have represented persons who will reorganize the road. The Penobscot Central Railway, which runs from Bangor to Hudson, is about 25 miles long, was built in 1898, and was bonded three years ago for $250,000. A year or so ago interest was defaulted.

BALTIMORE, MD.—Two ordinances have been introduced in the first branch City Council looking to the extension of the lines of the United Railways & Electric Company.

HAGERSTOWN, MD.—W. A. Morgart and De Warren H. Reynolds, of Cumberland, who are at the head of the company that expects to build an electric railway from Hagerstown to Waynesboro, are said to have made arrangements for beginning work on the road at once.

DETROIT, MICH.—The Detroit, Ypsilanti, Ann Arbor & Jackson Railway has decided to extend the Ypsilanti-Saline line to Adrian, and the Jackson line to Lansing.

LEOMINSTER, MASS.—The Worcester Consolidated Street Railway Company is soon to apply for a franchise for its new line from Leominster to Worcester.

BAY CITY, MICH.—The franchise of the Detroit & Bay City Traction Company has been granted by Council. The necessary right of way has been practically secured and the contracts for the construction will soon be let.

BRAINERD, MINN.—The Mille Lac & Minneapolis Electric Railway has been incorporated with a capital of $40,000, by V. S. Kathan, More, Minn., J. N. True, Little Falls, and others.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed by the Hutchinson & Western Railway Company. The company starts with a capital stock of $50,000 with the privilege of increasing it to $1,000,000. It has the right to use either steam, gasoline or electricity as motive power. The officers are L. McGrory, president; William E. Ellis, vice-president; Cyrus A. White, secretary. The headquarters of the road are to be in this city.

MERIDIAN, MISS.—The Meridian Light & Railway Company will expend $100,000 on improvements of its line.

SEDALIA, MO.—The Sedalia Transit Company has incorporated. It is organized as follows: H. S. Rumsey, of St. Louis, president; Joseph Clarke, of St. Louis, vice-president; W. H. Powell, of Sedalia, secretary and treasurer.

KANSAS CITY, MO.—The Kansas City & Bonner Springs Electric Railway Company has been granted the right to construct and operate an electric railway from Bethel, Kan., to Bonner Springs.

AUBURN, N. Y.—All arrangements have been perfected for building the Auburn & Ithaca Traction Company's proposed road, work to begin in the spring. L. W. Serrell, of New York, is engineer of the company.

BINGHAMTON, N. Y.—The project of building an electric railway from Binghamton to Earlville in the bed of the abandoned Chenango Canal is looked upon with favor by many, and committees are at work on the matter.

MILFORD, N. Y.—A committee composed of S. W. Barnum, of Cherry Valley; Bertrand Roberts, of Rosebloom; Charles Eckler, of Middlefield, and John Wilcox, of Milford, is considering the advisability of building an electric railway between Cherry Valley and Milford.

ALBANY, N. Y.—Meetings of the directors of the United Traction Company and of the Cohoes Railway were held in Albany, and a lease of joint traffic agreement between the two companies was considered and approved. The matter is to be submitted to the stockholders of the companies.

SCHENECTADY, N. Y.—It is reported that the Delaware & Hudson Company is having a large car made at the General Electric works, designed to carry eighty passengers. It is propelled by electricity, generated by a gasoline engine, the dynamo operating motors attached to the axles. The car will be placed on the Cooperstown branch.

NORWICH, N. Y.—The Chenango Railroad Company has been organized among Boston and New York men under the laws of Massachusetts, for the purpose of constructing and operating an electric railway through the Chenango Valley. H. C. Stratton, of Oxford, who has been looking after the Oxford interest of the promoters of the scheme, says that the capital stock of the new company is small, as the organization at this time was perfected for the purpose of securing rights of way and other privileges.

ROCHESTER, N. Y.—The new electric road to connect Rochester and Lyons will require the expenditure of $2,500,000. All the securities have been disposed of and it is the intention of the promoters to have the road in operation by Dec. 1, 1905. The entire distance, 35 miles, will be double tracked and the through cars will be equipped with four 100-hp motors. The owners of the road are Lyman C. Smith, William Nottingham, H. S. Holden, W. A. Holden, C. D. Beebe, W. H. Stansfield, A. E. Nettleton, W. K. Pierce, F. C. Soule and A. K. Hiscock, of Syracuse, and F. W. Roebling, of New York.

LEGAL.

NEW YORK TROLLEY LEASE.—The Appellate Division of the New York Supreme Court has handed down a decision affirming the judgment of Justice Scott dismissing the complaint of Isidor Wormser, Jr., against the Metropolitan Street Railway Company and the Interurban Street Railway Company and denying the injunction asked. Mr. Wormser sought to set aside the lease executed Feb. 14, 1902, by which the Metropolitan Company leased its properties to the Interurban Company for 999 years. Mr. Wormser also sought to restrain the plan to provide money to pay the Metropolitan's unfunded debts and the expense of the electrical equiptment. Justice Patterson wrote the opinion, in which all the justices concur. The opinion finds that the Metropolitan had the power to make the lease, that it was authorized by the stockholders, and that there was no fraud or wrong perpetrated upon the stockholders, but that the acts, whether prudent or imprudent, of the trustees or other persons in fiduciary relations, were performed in perfect good faith.

FRANCHISES FOR AUTOS.—The important question whether the operators of the sight-seeing automobiles have the legal right to use the public streets without first having obtained a franchise from the city was argued this week in New York City before Justice Amend in the Supreme Court. The case was brought into the courts by the Hackdrivers' Union. One of the members of the union caused the arrest of James Tallon, an auto operator, on Sept. 9, and, to test the matter, Magistrate Moss held Tallon for trial in the Court of Special Sessions. Then Tallon's counsel, J. A. Hodge, got a writ of habeas corpus. The writ was made returnable before Justice Amend. Counsel for the automobile company contended that there was no evidence that Tallon had violated any law and that the sight-seeing coach did not come within the law regulating the operation of stages carrying passengers, because it had no fixed route and did not take on and let off passengers en route. Charles Knox and J. T. Dooling, counsel for the Hackdrivers' Union, argued that the company ought to have obtained a franchise from the Mayor and Board of Aldermen. To get such a franchise, counsel said, the company should have obtained first the consent of the majority of the property owners along the line of streets used and that of any railroad company occupying a street where the auto coaches were operated for more than a thousand feet. Assistant District Attorney Johnstone appeared for the People, supporting the charge against Tallon. Justice Amend reserved decision. The case will be carried to the higher courts.

OBITUARY.

PROF. C. S. LEMSTROM.—We regret to be advised by his widow of the death of the distinguished Russian scientist, Prof. Charles Selim Lemstrom, of the University of Helsingfors, Finland, on October 2, in his 66th year.

F. B. BRISTOL.—We regret to report the death of Mr. Frank B. Bristol, of the Bristol Mfg. Company, Waterbury, Conn., which occurred Nov. 21 as the result of a collision between a railroad train and an automobile which Mr. Bristol was driving. The automobile was rapidly nearing the tracks of the New York, New Haven & Hartford Railroad at Waterbury when Mr. Bristol saw a train approaching. As he was unable fo stop he apparently saw that his only chance was to gain the other side of the road before the train got on the crossing. He turned on all the power, but the train caught the automobile and Mr. Bristol was instantly killed. Mr. Bristol was first vice-president of the Bristol Mfg. Company, of which Prof. W. H. Bristol, of Stevens Institute, Hoboken, is president.

DR. THOMAS MESSENGER DROWN, president of Lehigh University, died at South Bethlehem, Pa., on Wednesday morning, Nov. 16. Dr. Drown was born March 19, 1842, and graduated from the Philadelphia Central High School in 1859. He then took up the study of medicine and three years later received the degree of M. D. from the University of Pennsylvania. After a brief period of practice as a physician, he took up chemistry as his life work. After taking courses in the subject at both Yale and Harvard he spent three years in Germany at Freiberg and at Heidelberg. In 1874 he became professor of chemistry at Lafayette College, Easton, Pa., and in 1885 was appointed to the same chair at the Massachusetts Institute of Technology. In the spring of 1895 he was elected president of Lehigh University. Dr. Drown was secretary of the American Institute of Mining Engineers for ten years from 1873. In 1887 to 1895 he was in charge of the chemical department of the investigation of the natural waters of Massachusetts, on which work some $250,000 has been expended by the State. Up to the time of his death he was consulting chemist of the Massachusetts State Board of Health. In 1890 he was appointed a member of an international committee to devise standard methods for the chemical analysis of iron and steel, in which work he played a leading part. In 1884 he was elected an honorary member of the American Institute of Mining Engineers, and in February, 1897, was elected president. The degree of LL. D. was conferred on him by Columbia University in 1895.

PERSONAL.

MR. H. F. PARSHALL, the consulting electrical engineer, of London, is in the United States on professional work.

MR. T. L. TOWNSEND announces that he has withdrawn as general manager of the Vallee Bros. Electrical Company, Philadelphia, Pa.

MR. ROBERT W. BLACKWELL, of the Anglo-American Company bearing his name in Europe, is visiting this country again from London.

MR. GEO. L. COLGATE has recently been in New York in the interest of the Kuhlman transformer, made at Elkhart, Ind., of which he is general Eastern and export agent.

MR. FRANCIS BLOSSOM, of the electrical engineering and contracting firm of Sanderson & Porter, New York City, is on a short trip to Europe. He will be back in a fortnight.

MR. T. DAVIDSON BROWN, who has been with the Electro-Dynamic Company for the past eight years, during the last six of which he filled the position of general purchasing agent, has resigned and intends to enjoy a rest of some months before again taking up active work.

MR. J. W. McCROSKY, formerly chief engineer of Le Capital Tramways Company, which operates an extensive electric traction system in Buenos Ayres—now being extended—has returned from South America, where he recently went on behalf of the J. G. White & Company interests.

MR. P. G. GOSSLER, vice-president of the electrical engineering and contracting firm of J. G. White & Company, New York City, has sailed for Porto Rico for the purpose of inspecting the property of the San Juan Light & Transit Company, of which concern he was recently elected president, vice Mr. Geo. H. Walbridge.

PROF. CHARLES E. MUNROE, of the George Washington University, Washington, D. C., read an interesting paper at the St. Louis International Congress of Arts and Sciences entitled "The Relations of Technical Chemistry to the Other Sciences." The paper is reprinted in the current issue of the George Washington University *Bulletin*.

MR. R. E. HOWARD, writing in the *Country Gentleman*, complains that while he was attending the International Electrical Congress at St. Louis, he was greatly surprised at the absence of any treatment of subjects connected with the application of electricity to agriculture. He then points out many familiar ways of utilizing electricity on the farm.

MR. ERNEST GONZENBACH, engineer of the Youngstown & Southern Railway Company, Youngstown, Ohio, has been awarded the annual medal of the Western Society of Engineers for the most meritorious paper on an electrical subject presented to that society during the past year. The paper upon which this distinction was bestowed was presented by Mr. Gonzenbach

LANGLEY-GUDGER.—The marriage is announced of Mr. John Wesley Langley, on November 23, at Asheville, N. C., to Miss Emma Katherine Gudger, daughter of Mr. and Mrs. James Madison Gudger, Jr. The marriage took place at the First Baptist Church, and was followed by a reception at the bride's home. Mr. and Mrs. Langley will be at home at the Marlborough, Washington, after January 1.

MR. H. HOBART PORTER, JR., of Sanderson & Porter, has returned from a trip to the South where he recently went in connection with the New Orleans Railways Company's projected extensions which will involve the construction of a new central station for light and general power purposes of 60,000-hp ultimate capacity. Sanderson & Porter are consulting engineers for the installation work.

MR. JOSE LITZENSTATTER, of Mexico City, the instructor of federal telegraphers in the operation of the telegraph printing machines, who recently obtained a concession from the Mexican Government for the installation of a new telephone system in the capital of the Southern Republic, is due in New York next week en route for Europe. He will first visit Stockholm, where he will consult with the L. M. Ericsson people who are members of the syndicate which is to finance the enterprise. Afterward he will go to Russia for the purpose of investigating the Moscow and Warsaw telephone systems, particularly the former, and will minutely study the manner of distribution employed. Mr. Sitzenstatter expects to return to this side about Feb. 15. By the terms of the franchise work on the Mexican system must start by May next.

before that society on March 18, 1903. It was entitled, "The Third-Rail for High-Speed Electric Service."

NEW MEN IN JERSEY.—At a meeting of the directors of the Public Service Corporation, held at Newark, N. J., on Nov. 15, the resignations of Anthony R. Kuser, as first vice-president, and Randall Morgan, of Philadelphia, as second vice-president of the corporation were accepted and the titles and offices of first, second, third and fourth vice-presidents were abolished. A. B. Carleton, of Elizabeth, formerly third vice-president; John J. Burleigh, of Camden, who was formerly fourth vice-president, and Charles A. Sterling, of East Orange were elected vice-presidents of the company.

MR. CHARLES T. YERKES has arrived in New York from London, and speaks hopefully of his underground railway enterprise. In the course of an interview, he said: "We ventilate through our stations and force the air out in the same way that they do in mines. My opinion is that this is the proper way to ventilate tunnels. Another thing we paid great attention to in the construction of our tunnel was that everything in it, from the equipment to the advertising signs, must be fireproof. The cards and signs are all of metal, and even the cross ties are buried in cement. I think judicious advertising all right. The signs relieve the monotony of the tunnel, and in Paris the effect is very artistic. On the other side the people do not complain of the advertising. There is, however, this difference: the underground railways over there are private, while here the Subway is a municipal property."

Trade Notes.

JANDUS AWARD.—We are informed that the Jandus Electric Company has received a gold medal, the highest award, for arc lamps at the St. Louis World's Fair.

GRAPHITE LUBRICANTS.—The Joseph Dixon Crucible Company, Jersey City, has issued a new catalogue describing the many forms of graphite lubricants of its manufacture. In interest portion of the pamphlet is devoted to the theory of lubrication, with particular reference to graphite lubricants.

OILING SYSTEM.—The U. S. Treasury Department, after a careful investigation, has selected the "Admiralty" oiling system for the delivery of cylinder oil and engine oil to the three cross compound Rice & Sargent engines in the power plant of the new U. S. Mint, Denver, Col. The J. H. Siegrist Company, New York, is the sole maker of this apparatus.

THE AMERICAN INSULATING MACHINERY COMPANY, Philadelphia, Pa., announces its removal to the corner of Hancock and Oxford Streets. In its new location it has more than doubled its former floor space, at the same time increasing its facilities in other directions. It is developing several new machines in its line that promise well. Its volume of business is on the increase.

THE NATIONAL WOOD PIPE COMPANY, of Los Angeles, Cal., has issued an attractive "Log Book," containing extracts and illustrations from its office files, showing pipe lines it has built and fac-simile letters from engineers and others for whom the work has been done. It is believed that this little book will be interesting to engineers, water works and electric power companies, as well as all others interested in pipe work.

ELECTRIC HEATING AND COOKING.—L. Brenne, 2 Boul. St. Martin, Paris, has issued a 40-page catalogue devoted to the very extensive line of electric heating and cooking apparatus of his manufacture. A glance through the pages of this publication will be a revelation to many as to the commercial development in this art. Visitors to the St. Louis Exposition will recall the Brenne grill, which is one of the features of the electrical department.

ALLEN SOLDERING STICK.—That the Allen soldering stick is increasing in popularity is evident from the fact that consumers refuse to accept any substitute therefor. The L. B. Allen Company, Inc., Chicago, is in receipt of many letters from users who complain that they cannot get the Allen soldering stick of dealers. This is the reason why the company is doing so much direct business. It reports that its sales increased 25 per cent in the dull season.

COOLEY ENGINES.—Mr. J. F. Cooley, president of the Cooley General Development Company, of Boston, was a visitor in New York during the past week. He said that the interest that his engine had developed in all parts of the world was very marked, and was very encouraging to the manufacturer. Inquiries have been received from all parts of the world, not only making inquiries concerning the engine, but actually placing orders, and at the present time his books show communications from Natal, Venezuela, New Zealand, St. Petersburg, Spain and other countries on the continent of Europe.

UNDERWRITER FIRE PUMPS are described in Bulletin W 114, recently issued by Henry R. Worthington, 114 Liberty Street, New York City. These pumps are designed to meet the specifications of the insurance companies and are fitted with air and vacuum chambers, relief valves, pressure gauges and the other special devices required. All rubbing parts are of composition metal to prevent rusting and sticking, and the pumps differ considerably from ordinary trade pumps. The back cover of the pamphlet shows the fourteen Worthington fire pumps supplied to the Louisiana Purchase Exposition for the protection of the buildings there.

THE AMERICAN FUSE COMPANY, Chicago, announces that it has made a number of improvements in connection with its general line of protective apparatus, and that it now has a larger and better stock of its standard American specialties than ever before. Every improvement has been introduced with the object of improving the quality of the goods, without increasing the cost. Those interested in protectors of all kinds should write the American Fuse Company for information and prices. A new catalogue will be issued within the next two weeks, which, it is said, will be one of the most attractive and valuable catalogues ever issued by a protector manufacturer.

JACOBSON AUTOMATIC GAS ENGINE.—Charles Jacobson, Warren, Pa., has sold to G. Elias & Bro., of Buffalo, N. Y., a 250-hp horizontal tandem Jacobson gas engine. Among the special points of this type of engine are that it is provided with a bushed cylinder, enabling a larger bushing to be inserted to maintain the horse-power in case of change from natural to producer or ordinary gas; it comprises a new scavenging system that may be used either with natural or other gas, and its graduated charge system is so designed that when the load becomes so light that there is not enough admission for proper compression, the gas is cut off entirely and only just enough air admitted to release the vacuum.

NORTHERN ELECTRICAL GENERATORS.—The Lee Paper Company, of Vicksburg, Mich., has just ordered a 200-kw generator from the Northern Electrical Mfg. Co., of Madison, Wis., for the equipment of its new mill. This is the most recent in a long series of sales of Northern apparatus in paper-mill work, the most prominent installation being the plant of the Consolidated Water Power & Paper Company, of Grand Rapids, Wis., in which are operated a quantity of Northern motors of all sizes, as well as two 300-kw direct-current generators. The Consolidated Water Power & Paper Company's plant contains, among other motors, two large single-voltage variable speed motors operating from the mill power circuit and giving speed variations from 300 to 500 r.p.m., corresponding with machine speeds of 50 to 500 feet per minute.

BOILER FLUE CLEANER.—The Power Specialty Company, Detroit, Mich., is placing upon the market a new and useful device for cleaning the flues of steam boilers. It is installed in the rear wall of the boiler and blows the soot, with the natural draught of the boiler, to the front and out through the chimney. The thorough cleaning of all the tubes does not take more than 5 minutes, because it cleans in each operation a cluster of tubes covering a space of 4 ft. 6 in. in diameter. It does away with loss of steam pressure and saves in fuel, and consequently there is no loss of speed and no necessity for extra stoking and fuel. It practically does away with the firemen's work and enables them to keep a uniform pressure of steam with ease. The device, as evidenced by the testimonials, saves much time and labor, and is giving the best of satisfaction to users.

MR. L. W. STANTON, of Cleveland, Ohio, is reconstructing the Elyria, Ohio, telephone exchange. Mr. Stanton is rebuilding a number of plants and taking up the engineering and supervision of the management of same with a view of increasing the earnings of the plants. He reorganizes the various departments, and through a system of records and reports keeps a close check on various departments, such as the cost of operation, maintenance, etc. The system of accounting is one which has been worked out by F. H. MacPherson, Chartered Accountant under the Canadian Government, and Mr. Stanton. They have gone over a number of the leading telephone bookkeeping systems, and worked out a system which gives clear and concise information. By an agreement with the owners of the plants, the managers of the plants under Mr. Stanton's supervision are promoted to a better position as they prove themselves capable. Such a system is beneficial both to the owners and the men look for advancement.

TRIED BY FIRE.—Three Westinghouse 62½-kw engine type generators which have been in service in the basement of the New England Building, in Cleveland, Ohio, have recently been subjected to a test which shows up the construction in a very good light. A fire occurred in the basement where the generators were installed, and completely burned away the insulation on the outside of the field coils; the fire department played upon these machines with six lines of hose for one hour. Within one hour from the time the water was turned off the machines, one of them was in operation and carrying its full rated load. The second machine was put in operation later, and carried its full rate load, and at the present time two of these machines are operating under the load normally carried by all three of them. The insulation of the field coils withstood the fire perfectly, even though the outer protecting coverings were entirely consumed, and the heat was so intense as to burn and blister the finish on the frames. Electrical machinery, as usually constructed, is scarcely expected to stand a fire and water test, but it appears that such a guarantee might have been made on these generators.

LEEDS & NORTHRUP COMPANY AWARD.—The Leeds & Northrup Company, 259 North Broad Street, Philadelphia, Pa., informs us that its exhibit at the St. Louis World's Fair has received a grand prize. The apparatus covered by the prize is part of the exhibit of the National Bureau of Standards in the Electricity Building, and includes the Carey Foster bridge; Kohlrausch slide-valve bridge; standard resistances, apparatus for measuring low resistances; potentiometers; galvanometers of different types; keys; Rose curve tracer, etc. The National Bureau of Standards is making an extensive working exhibit and the apparatus above referred to was loaned to the Bureau by the Leeds & Northrup Company in order to avoid removing the equipment of the Bureau from Washington. The instruments are noted for the accuracy of results obtained and their excellent finish was widely commented on. There were many other instruments of the Leeds & Northrup Company's make in the same exhibit, but on account of their being the property of the Bureau of Standards they were not open for award. The Leeds & Northrup Company is justly proud of its success in securing the grand prize.

"COLUMBUS" GAS AND GASOLINE ENGINES.—The Columbus Machine Company, Columbus, Ohio, describes in its catalogue the construction and principle of operation of its gas and gasoline engines. It has put upon the market a line of geared pumping engines and hoisting engines, also a traction engine for the agricultural trade. Its gas engine is of the single cylinder, hit and miss, four cycle, non-scavenging type. All engines are equipped with electric ignition of special design, and the governor is very simple, reliable and sensitive and holds the engine within a very close limit of variation and speed, thus securing a steady and economical machine. The engines are furnished with either gas or gasoline equipments, and the change from one to the other can be made without stopping the engine or without missing a single impulse. On account of their close regulation they are are particularly well adapted for the driving of dynamos. The catalogue is well illustrated with views of the different classes of engines made by the company, and tables are given of dimensions, etc. A comparison of cost of operation of a 20-hp steam engine with a 20-hp gas and gasoline engine, doing a 20-hp work for 10 hours, shows very favorably for the latter, the figures for the steam engine being $4.30; for the gasoline engine $2.30 and for the gas 90 cents.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 15, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

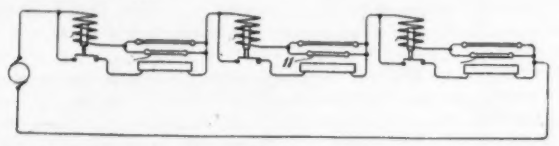
774,749. PORTABLE ELECTRIC LIGHT; Edwin R. Gill, New York, N. Y. App. filed Jan. 25, 1902. A tube having a small lamp at one end and containing the batteries supplying the lamp, a thrust-block being fitted in between the lamp and the battery to protect the lamp.

774,759. PORTABLE HIGH FREQUENCY DEVICE AND VACUUM TUBE STAND; Thomas B. Kinraide, Boston, Mass. App. filed June 27, 1904. The tube is mounted directly upon the secondary itself to avoid losses in transmission and these two parts are portably mounted upon a suitable standard.

774,760. SELF-CONTAINED HAND ELECTRODE; Thomas B. Kinraide, Boston, Mass. App. filed July 5, 1904. Comprises a portable inclosure provided with a carrying device adapted to be grasped by the hand, the inclosure adapted to be connected to a source of high frequency current and containing within itself means for developing from said current a high-frequency, high-potential disruptive discharged current.

774,764. SYSTEM OF ELECTRICAL DISTRIBUTION; Paul M. Lincoln, Pittsburg, Pa. App. filed Sept. 30, 1903. (See Current News and Notes.)

774,769. IGNITER FOR OIL LAMPS; Svend M. Mayer, Brooklyn, N. Y. App. filed Sept. 9, 1902. The lighter is mounted in the central draft tube opposite the air-distributing holes and can be projected through one of the holes to light the wick.



774,812.—System of Distribution for Electric Glower Lamps.

774,770. CENTRAL-ENERGY TELEPHONE SYSTEM; Kempster B. Miller, Chicago, Ill. App. filed Dec. 19, 1900.

774,789. ELECTRIC ARC LAMP; Ralph Scott, Wilkesbarre, Pa. App. filed Oct. 14, 1903. Details.

774,800. CONTROLLER FOR ELECTRIC MOTORS; Hermon L. Van Valkenburg, Pittsburg, Pa. App. filed April 14, 1904. Radial bars are attached to the edge of the disc on both faces and connected together across the rim of the disc plates over which the trailer rubs.

774,812. SYSTEM OF DISTRIBUTION FOR ELECTRIC GLOWER LAMPS; Alexander J. Wurts, Pittsburg, Pa. App. filed Nov. 9, 1900. Lamps connected in series each have a glower, a heater, a cut-out coil in series with the heater, a cut-out coil in series with the glower and a resistance coil connected in shunt to the glower and heater and in series with the cut-out coils.

774,813. ELECTRIC SIGNALING SYSTEM; Samuel M. Young and Fitzhugh Townsend, New York, N. Y. App. filed Aug. 22, 1904. Improvements on prior inventions of Young, by which the number of sources of energy may be decreased, besides various other improvements.

774,831. ELECTRIC BURGLAR ALARM SYSTEM; Clyde Coleman, Chicago, Ill. App. filed Dec. 17, 1896. Details.

774,836. VACUUM ARC LAMP; Hubert Emonds, Aix-la-Chapelle, Germany. App. filed Jan. 30, 1904. Both carbons and the clutch are located in a sealed chamber, the clutch being actuated by magnetic poles presented to and moved against, the outside walls of the chamber.

774,847. THERMOSTAT; Max J. Levy, New York, N. Y. App. filed Feb. 13, 1904. Details.

774,876. ELECTRIC ARC LAMP; Thomas Hamilton-Adams, London, Eng. App. filed Aug. 21, 1903. A tube in communication with the inner globe of an arc lamp, extends some distance upward and serves to radiate the heat of the gases and avoid the necessity for other ventilation.

774,882. TEMPERATURE REGULATOR; Charles E. Jewell, Auburn, N. Y. App. filed Aug. 20, 1902. Details.

774,896. ELECTRIC SAFETY APPARATUS FOR CARS OR TRAINS; William P. Robertson, Bronxville, N. Y. App. filed May 12, 1904. The doors of the cars actuate circuit closers so that the motorman cannot start the train until all doors are closed.

774,897. BLOCK SIGNAL SYSTEM FOR ELECTRIC RAILROADS; Howell W. Souder, Tamaqua, Pa. App. filed Dec. 7, 1903. Details.

774,905. TELEGRAPH REPEATER; William E. Athearn, New York, N. Y. App. filed May 13, 1904. The repeating from one line to another is accomplished by the relays alone, the transmitting sounders being omitted; other improvements are introduced.

774,922. APPARATUS FOR RECEIVING ELECTRICAL IMPULSES; Daniel W. Troy, New York, N. Y. App. filed April 11, 1904. A tube of filings is subjected to an alternating magnetic flux during the period that received currents are in action. The received currents pass through a winding surrounding the tube.

774,923. RECEIVER FOR TELEPHONES OR THE LIKE; Daniel Watts Troy, New York, N. Y. App. filed June 24, 1904.

774,929. PROTECTING-DIAPHRAGM FOR TELEPHONE-TRANSMITTERS; William M. Bashlin, Warren, Pa. App. filed Oct. 28, 1903.

774,943. CONTROLLER; Ray P. Jackson, Wilkinsburg, Pa. App. filed Jan. 20, 1904. An apparatus for slowly rotating the field magnet of an alternating current machine comprising means for successively supplying direct current energy to the several portions of the polyphase armature winding and for alternately decreasing and increasing, in gradations, the amount of current supplied to each of said portions.

774,954. METHOD OF ROTATING FIELD-MAGNETS OF DYNAMO-ELECTRIC MACHINES; Charles F. Scott, Edgewood Park, Pa. App. filed Sept. 16, 1903. (See Current News and Notes.)

774,955. METHOD OF ROTATING THE FIELD-MAGNETS OF ALTERNATING-CURRENT GENERATORS; Charles F. Scott, Pittsburg, Pa. App. filed June 30, 1904. (See Current News and Notes.)

774,956. METHOD OF ROTATING THE FIELD-MAGNETS OF ALTERNATING-CURRENT GENERATORS; Charles F. Scott, Pittsburg, Pa. App. filed June 30, 1904. (See Current News and Notes.)

774,991. REGISTER FOR TELEPHONES; George S. Nickum, Salt Lake City, Utah. App. filed April 4, 1904.

775,016. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed March 9, 1903. Details of a push switch operating with a snap action.

775,021. ELECTRICAL VALVE CONTROLLING MECHANISM; Isaac G. Waterman, Santa Barbara, Cal. App. filed June 21, 1902. A system for electromagnetically actuating hot and cold water valves whereby water for a bath can be prepared by merely pushing the proper circuit buttons.

775,037. BRANCH BOX FOR INSULATED ELECTRIC WIRES; Morton Havens, Jr., Albany, N. Y. App. filed Nov. 3, 1903. A box to be attached to the end of a conduit and having a number of bushed openings for the various conductors.

775,050. METHOD OF SELECTING ELECTRICAL IMPULSES; Daniel W. Troy, New York, N. Y. App. filed April 8, 1904. The method consists in splitting the phase of received impulses by means related to the frequency of the impulses desired to be selected, and operating vibratory receiving apparatus by the mutual action of the phase differing components of such split.

775,051. ELECTRICAL VALVE CONTROLLING MECHANISM; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 4, 1902. Further improvements for controlling the flow of water for baths.

775,052. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed Jan. 31, 1903. An improvement on the invention of patent 732,477, June 30, 1903.

775,053. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed June 29, 1903. A number of switches mounted in one casing for controlling the flow of water to and from a bath tub and lavatory.

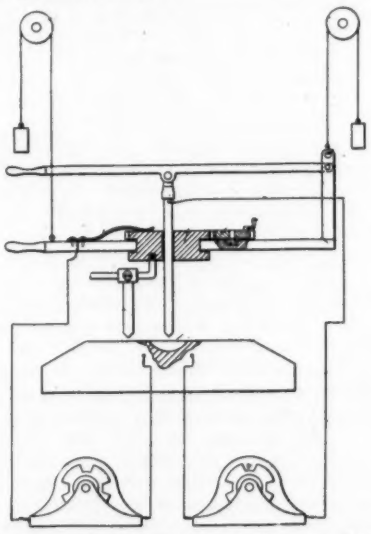
775,055. ELECTRIC SWITCH; Isaac G. Waterman, Santa Barbara, Cal. App. filed Sept. 7, 1904. An indicator is provided in connection with a push switch to indicate which of the circuits controlled by the switch has previously been completed.

775,056. ELECTRICAL CONTACT CONTROLLING FLOAT; Isaac G. Waterman, Santa Barbara, Cal. App. filed Sept. 7, 1904. An electrical contact controlling float adapted to complete the circuit of the electromagnet supply valve to cut off the water supply to the bath tub when the water therein reaches the proper height and then to automatically break the circuit to avoid continuance of the current.

775,079. SIGNAL FOR THE DEAF; Albert Ekberg, Minneapolis, Minn. App. filed Sept. 5, 1903. Details.

775,082. RAIL BOND; Edward P. Howe, Newburyport, Mass. App. filed Feb. 23, 1904. Plates of solder are rivetted to the feet of the bond and have overturned lips preventing them from changing their position on the rivets.

775,113. COHERER; Walter W. Massie, Providence, R. I. App. filed March 4, 1904. A small quantity of magnetic filings bunched around the end of the terminal, rest upon a body of non-magnetic filings to increase the sensitiveness of the instrument.



775,170.—Process of Repairing Castings or the Like.

775,145. ELECTROMAGNET; William Meyer, Chicago, Ill. App. filed Aug. 26, 1901. One leg of a horseshoe frame is wound with a coil and an angular armature is poised on the end of the other leg and adapted by attraction of the core to close the magnetic circuit.

775,165. SAFETY ALARM; Levi N. Coffield, Clarksburg, W. Va. App. filed June 30, 1903. A piston operating upon contacts is actuated by gas pressure to sound an alarm when the pressure becomes abnormal.

775,170. PROCESS OF REPAIRING CASTINGS OR THE LIKE; James H. Gravell, Philadelphia, Pa. App. filed March 10, 1904. The process consists in heating the part to be repaired, establishing an arc between said parts and an electrode of the same metal, thereby fusing a portion of the electrode and uniting it to the main part and then permitting the casting and applied metal to gradually cool.

775,201. TELEPHONE SYSTEM; William R. Whitehorne, Bethlehem, Pa. App. filed April 27, 1904.

775,226. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Feb. 4, 1903.

775,227. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Feb. 14, 1903.

775,228. TELEPHONE-EXCHANGE SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Feb. 14, 1903.

775,229. TELEPHONE-EXCHANGE; Harry G. Webster, Chicago, Ill. App. filed Feb. 14, 1903.

775,230. CIRCUIT-CHANGING APPARATUS; Harry G. Webster, Chicago, Ill. App. filed Dec. 7, 1903.

775,254. ADJUSTABLE SUPPORT FOR TELEPHONE-RECEIVERS; George W. Sebastion, Ashland, Ky. App. filed Jan. 4, 1904.

775,274. INSULATED ELECTRIC CONDUCTOR; John A. Heany, York, Pa. App. filed Feb. 4, 1904. Flocculent asbestos and gluey material are applied to a wire which has been notched successively along its surface.

775,276. TROLLEY SYSTEM FOR OVERHEAD ELECTRIC LINES; James B. Kline, Warren, Pa. App. filed Feb. 1, 1904. Details.

775,284. ELECTRIC TESTING CLIP; Harry Frankel, New York, N. Y. App. filed Dec. 2, 1903. A pair of spring jaws fitted to the end of conductors for temporary engagement with binding posts and other permanent terminals for testing purposes.